INSTRUCTION MANUAL
OSCILLOSCOPE
MODEL COS6100

SUPPLIED BY
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KIKUSUI
ELECTRONICS CORP.

MODEL COS6100
OSCILLOSCOPE

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1. GENERAL

1.1 Description

Kikusui Model COS6100 Oscilloscope is a universal-type portable oscilloscope which is capable of 5-channel 12-trace display. It employs a 6-inch rectangular type cathode-ray tube with red internal graticule.

The COS6100 oscilloscope is sturdy, easy to operate, and extremely reliable. This scope has many convenient features and special functions which make it an ideal instrument for diversified types of research and development of electronic equipment. It can also be efficiently used in production line maintenance and service applications.

1.2 Features

The features of the COS6100 Oscilloscope can be summarized as follows:

(1) Ease of use:

Light torque lever switches and pushbutton switches are used. These and other controls are laid out in the most convenient locations making the oscilloscope extremely easy to operate.

(2) Clear waveform observation:

The cathode-ray tube is a 6-inch large-screen rectangular type CRT with a red internal graticule of 80 mm × 100 mm (3.15 in. × 3.94 in.) The red graticule produces a high resolution background for easy waveform viewing.

(3) High acceleration voltage (20 kV):

The high acceleration voltage of the CRT ensures a bright trace for observation and photography.

(4) High sensitivity and wide frequency bandwidth:

The maximum vertical sensitivity is 1 mV/DIV (with ×5 MAG) and the frequency response is 100 MHz or greater (-3 dB).

(5) High input impedance:

The input impedance of CH1, CH2, CH3, CH4 and CH5 (EXT TRIG) is 1 MΩ ±1%, 20 pF ±2 pF, allowing the use of 10× Probes.

(6) 5-channel simultaneous display:

The COS6100 employs a new type of vertical mode switching circuit which enables display of any combination of CH1, ADD (CH1 ± CH2), CH2, CH3, and TRIG VIEW (CH4 and CH5). Up to five channels can be displayed simultaneously; up to twelve traces can be displayed when in the alternate sweep mode.

(7) Trigger level lock:

A new trigger level lock circuit eliminates the requirement of triggering adjustments on most signals. (Manual control is still available for triggering on complex waveforms.)

(8) Stable alternate triggering function:

When in the alternate triggering mode, stable triggering can be attained even when the signals of CH1, CH2 and CH3 are not time releated. (patent pending)

(9) TV sync triggering:

The COS6100 has a sync separator circuit, which allows triggering for TV V signal and TV H signal. It is automatically switched with the TIME/DIV control.

(10) B END'S A switch separated from holdoff control knob:

The B END'S A switch is installed separately from the holdoff control switch. Holdoff control can be used while in the B END'S A mode.

(11) Maximum sweep time 2 nsec/DIV with ×10 MAG function:

With the ×10 MAG function, the highest sweep speed of 20 nsec/DIV can be multiplied by a factor of 10 to attain a maximum sweep speed of 2 nsec/DIV.

(12) Alternate sweep:

The A sweep and the delayed sweep can be viewed simultaneously in the alternate mode.

(13) Linear focus:

Once the beam focus is adjusted, it is automatically maintained in this state regardless of changes in intensity.

(14) Multiple-channel X-Y operation:

By using the CH3 HOR channel as the X-axis input and all other channels as the Y-axis inputs, up to four channels of X-Y operation can be viewed.

Vertical axes

Item	Specification	Remarks
CH1 and CH2		
Sensitivity	5 mV/DIV - 5 V/DIV 1 mV/DIV - 1 V/DIV (when ×5 MAG)	1-2-5 sequence, 10 ranges
Sensitivity accuracy	±2% ±4% (when ×5 MAG)	10 to 35°C (50 to 95°F), at 8 DIV
Variable vertical sensitivity	To 1/2.5 or less of panel-indicated value	
Frequency bandwidth	DC - 100 MHz (-3 dB) DC - 10 MHz (-3 dB), when ×5 MAG AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV. Except when in bandwidth limit mode
Input coupling	AC, DC, GND	
Input impedance	1 MΩ ±1%, 20 pF ±2 pF	
Allowable input voltage	400 V (DC + AC peak)	Frequency 1 kHz or lower
Square wave characteristics	Overshoot: Not greater than 3% (at 10 mV/DIV range) Other distortions: Not greater than 2%	Other ranges: Add 5% VARIABLE knob is CAL'D position.
CH3 (HOR)		
Sensitivity	0.1 V, 1 V/DIV	
Sensitivity accuracy	±3%	10 to 35°C (50 to 95°F)

Item		Specification	Remarks
	Frequency bandwidth	DC - 100 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	
	Input coupling	AC, DC, GND	
	Input impedance	1 MΩ ±1%, 20pF ±2 pF	
	Allowable input voltage	400 V (DC + AC peak)	Frequency 1 kHz or lower
	Square wave characteristics	Overshoot: Not greater than 5% Other distortions: Not greater than 3%	
CH4 and CH5		CH4: A TRIG EXT input CH5: B TRIG EXT input	
	Sensitivity	0.1 V, 1 V/DIV	
	Sensitivity accuracy	±3%	10 - 35°C (50 - 95°F)
	Frequency bandwidth	DC - 100 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 4 DIV
	Input coupling	CH4: AC, HF REJ, TV, DC CH5: AC, HF REJ, LF REJ, DC	Selectable with the coupling switch
	Input impedance	1 MΩ ±1%, 20 pF ±2 pF	
	Allowable input voltage	100 V (DC + AC peak)	Frequency 1 kHz or lower
	Square wave characteristics	Overshoot: Not greater than 10% Other distortions: Not greater than 5%	
Rise time		Approx. 3.5 nsec (Approx. 35 nsec when ×5 MAG)	

Item	Specification	Remarks
Signal delay time	Approx. 40 nsec (with delay cable of approx. 100 nsec)	The displayed portion preceding the triggering point
Delay time differences among channels	Not greater than ±0.5 nsec among CH1, CH2, and CH3	
Polarity change	CH2 only	
DC balance shift	±0.5 DIV (±2.0 DIV when in ×5 MAG)	CH1 and CH2, at 10 mV/DIV
Display modes	Simultaneous displays of CH1, ADD (CH1 + CH2), CH2, CH3, and TRIG VIEW (CH4 and CH5) are possible in any combination. Single X-Y (CH1 for X-axis and CH2 for Y-axis) also is possible.	
Chopping repetition frequency	1 MHz/ (number of displayed channels) ±40%	
Common mode rejection ratio	50:1 or better at 50 kHz, sinusoidal wave	When sensitivities of CH1 and CH2 are set equal
Isolation between channels	At least 1000:1 at 50 kHz At least 30:1 at 100 MHz	At 5 mV/DIV range
Bandwidth limit	With filter for approx. 3 dB attenuation at 20 MHz	
CH1 signal output		
Output voltage	Approx. 10 mV per 1 DIV deflection amplitude on screen	50-ohm termination
Frequency bandwidth	DC - 100 MHz (-6 dB)	
Output resistance	Approx. 50 ohms	

Triggering

Item	Specification	Remarks
Internal trigger selection (INT TRIG switch)	CH1, CH2, CH3, ALT (When in ALT mode, a trigger source is selected depending on the vertical operation mode.)	When in ADD, the CH1 input signal is used as the trigger source signal.
A trigger Signal source	INT, LINE, EXT, EXT/10	
Coupling	AC, HF REJ, TV, DC	
Polarity	+ or -	
Sensitivity	DC - 20 MHz: 0.4 DIV (0.04 V) 20 - 100 MHz: 1.5 DIV (0.15 V) 100 - 130 MHz: 3.0 DIV (0.3 V) Video signal: 1.0 DIV (0.1 V) AC coupling: Attenuates signal components of lower than 10 Hz. HF REJ: Attenuates signal components of higher than 50 kHz.	The values enclosed in the parentheses are the input sensitivities when in the EXT trigger mode.
B trigger Signal source	INT, EXT, EXT/10	
Coupling	AC, HF REJ, LF REJ, DC	
Polarity	+ or -	
Sensitivity	DC - 20 MHz: 0.4 DIV (0.04 V) 20 - 100 MHz: 1.5 DIV (0.15 V) 100 - 130 MHz: 3.0 DIV (0.3 V)	The values enclosed in the parentheses are the input sensitivities when in the EXT trigger mode.

Item	Specification	Remarks
EXT trigger input	CH4 and CH5 input terminals used in common	
Input impedance	1 MΩ ±2%, 20 pF ±2 pF	
Maximum allowable input voltage	100 V (DC + AC peak)	Frequency 1 kHz or lower
AUTO mode	Satisfies the A trigger sensitivity specification for signal repetition frequency of 50 Hz of over.	
LEVEL LOCK	Satisfies the value of the above trigger sensitivity plus 0.5 DIV (0.05 V) for signal of duty cycle 20:80 and repetition frequency 50 Hz - 100 MHz.	

Horizontal axis

Item	Specification	Remarks
Horizontal axis display	A, A INT, ALT, B (DLY'D)	
A sweep		
Sweep mode	AUTO, NORM, SINGLE	
Sweep time	20 nsec/DIV - 0.5 sec/DIV 2 nsec/DIV - 50 msec/DIV (when in "× 10 MAG")	1-2-5 sequence, 23 ranges
Sweep time accuracy	±2%	10 to 30°C (50 to 95°F)
Variable sweep time	To 1/2.5 or slower of panel-indicated value	
Holdoff time	Continuously variable to 2 times or over of sweep length (time) at 20 nsec/DIV - 0.1 sec/DIV ranges	

Item	Specification	Remarks
B sweep		
Delay system	Continuous delay or triggered delay	
Sweep time	20 nsec/DIV - 0.5 sec/DIV 2 nsec/DIV - 50 msec/DIV (when in "×10 MAG")	1-2-5 sequence, 23 ranges
Sweep time accuracy	±2%	10 to 35°C (50 to 95°F)
Delay time	0.2 µsec - 5 sec	
Delay time accuracy	±2% of multidial-indicated value (except 0 - 0.50) ±3% of value read on screen	
Delay jitter	1/20,000 or less $\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{10\ \text{DIV}}$	Jitter width 0.5 DIV or less at A: 1 msec/DIV B: 1 µsec/DIV
Sweep magnification	10 times (maximum sweep time 2 nsec/DIV)	Both A and B
Magnified sweep time accuracy	0.1 µsec/DIV - 0.5 sec/DIV ranges: ±4% 20 nsec/DIV - 50 nsec/DIV ranges: ±5%	10 to 35°C (50 to 95°F)
Linearity	±3% ±5% (when in "×10 MAG")	
CH3 sweep (CH3 HOR)	CH3 input signal is used as sweep trigger signal. For vertical axes, any combination of CH1, ADD (CH1 + CH2), CH2, and TRIG VIEW can be simultaneously displayed in CHOP mode.	
Sensitivity	0.1 V, 1 V/DIV	Same as CH3
Sensitivity accuracy	±3%	Same as CH3

Item	Specification	Remarks
Frequency bandwidth	DC - 5 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 10 DIV
Phase difference between vertical axes	Not greater than 3° at DC - 100 kHz	
X-Y mode	X-axis: CH1 input signal Y-axis: CH2 input signal	
Sensitivity	5 mV - 5 V/DIV	Same as CH1
Sensitivity accuracy	±3% ±5% (when in "× 5 MAG")	10 to 35°C (50 to 95°F)
Frequency bandwidth	DC - 5 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 10 DIV
X-Y phase difference	Not greater than 3° at DC - 100 kHz	
Sweep signal output	A sweep signal	
Output voltage	Approx. 5 Vp-p	Zo ≒ 10 kΩ
Sweep gate output	A sweep gate signal	
Output voltage	Approx. 1 Vp-p	Zo ≒ 100 Ω

Z axis

Item	Specification	Remarks
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency bandwidth	DC - 10 MHz	
Input resistance	5 kΩ ±10%	
Allowable input voltage	50 Vp-p (DC + AC peak)	AC: 1 kHz or lower

Calibration voltage

Item	Specification	Remarks
Waveform	Positive-going square wave	
Frequency	1 kHz ±5%	
Duty ratio	Within 45:55	
Output voltage	2 V, 200 mV ±2%	
Rise time	Approx. 3 µsec	
Output resistance	2 V: Approx. 2 kΩ 200 mV: Approx. 200 Ω	

CRT

Item	Specification	Remarks
Type	6-inch rectangular type, internal graticule	
Fluorescent screen	P31 phosphor	
Acceleration voltage	Approx. 20 kV	
Effective screen size	8 × 10 DIV	1 DIV = 10 mm (0.39 in.)
Graticule	Internal graticule, continuously adjustable illumination	Red

Mechanical specifications

Item	Specification	Remarks
Dimensions of mainframe	310 W × 150 H × 400 D mm (12.20 W × 5.91 H × 15.75 D in.)	
Maximum dimensions	370 W × 190 H × 480 D mm (14.57 W × 7.48 H × 18.90 D in.)	
Weight	Approx. 9.5 kg (21 lbs)	

o Line power requirements

Voltage: 100 V, 115 V, 215 V, 230 V; with 10% allowance.
Selectable by connector change

Frequency: 50 Hz or 60 Hz

Wattage: Approx. 56 W (Approx. 66 VA)

o Operating environment

To satisfy specifications: 5 to 35°C (41 to 95°F), 85% RH

Maximum operating ranges: 0 to 40°C (32 to 104°F), 90% RH

o Accessories

961 BNC probes (10:1, 1.5 m) ..... (89-03-0230) 2
942A terminal adaptors ..... (W4-986-011) 3
Slow blow fuse (0.5A) ..... (99-02-0115) 1
Slow blow fuse (1 A) ..... (99-02-0120) 1
Power cord ..... (85-10-0120) 1
Instruction manual ..... ( ) 1

Power cord (USA and Canada) ..... (85-10-0170)
(European countries) ..(85-10-0140)

3. PRECAUTIONS BEFORE OPERATING THE OSCILLOSCOPE

3.1 Unpacking the Oscilloscope

The oscilloscope is shipped from the factory fully inspected and tested. Upon receipt of the instrument, please unpack and inspect it for any damage which might have been sustained during transportation. If any sign of damage is found, please notify the bearer and/or the dealer.

3.2 Checking the Line Voltage

The oscilloscope can operate on any one of the line voltages shown in the below table. Insert the line voltage selector plug in the corresponding position on the rear panel. Before connecting the power plug to an AC line outlet, be sure to check that the voltage selector plug is set in the position corresponding to the correct line voltage. Note that the oscilloscope may not operate properly or may be damaged if it is connected to a wrong voltage AC line.

When line voltages are changed, replace fuses as required.

Selector plug position	Nominal voltage	Voltage tolerance	Fuse
A	100 V	90 - 110 V	1 A, slow blow
B	115 V	104 - 126 V	
C	215 V	194 - 236 V	0.5 A, slow blow
D	230 V	207 - 253 V	

3.3 Environments

The normal ambient temperature range of this instrument is 0 to 40°C (32 to 104°F). Operation of the instrument outside of this temperature range may cause damage to the circuits.

Do not use the instrument in a place where a strong magnectic or electric field exists. Such fields may disturb the measurement.

3.4 CRT Intensity

In order to prevent permanent damage to the CRT, do not make the CRT trace excessively bright or leave the spot stationary for an unreasonably long time.

3.5 Maximum Voltages of Input Terminals

The maximum voltages of the instrument input terminals and probe input terminals are as shown in the following table. Do not apply voltages higher than these limits.

Input terminal	Maximum allowable input voltage
CH1, CH2, CH3 inputs	400 Vp-p (DC + AC peak)
EXT TRIG (CH4, CH5) input	100 Vp-p (DC + AC peak)
Probe input	600 Vp-p (DC + AC peak)
Z AXIS input	50 Vp-p (DC + AC peak)

Note: AC Frequency is 1 kHz or below.

4. OPERATION METHOD

4.1 Explanation of Front Panel (See Figure 4-1.)

o CRT circuits:

POWER ..... (1) Main power switch of the instrument. When this switch is turned on, the LED (2) above the switch is also turned on.

INTEN ..... (7) Controls the brightness of the spot or trace.

(PUSH BEAM FIND) Even when the beam is outside of the screen, it can be located by pressing this beam finder button.

B INTEN ..... (6) Potentiometer for adjusting trace intensity when in B sweep mode.

FOCUS ..... (5) Focusing the trace to the sharpest image.

ILLUM ..... (3) Graticule illumination adjustment.

TRACE ROTATION ..... (4) Potentiometer for aligning the horizontal trace in parallel with graticule lines.

Bezel ..... (27) For installing a camera mount

Filter ..... (28) Blue filter for ease of waveform observation. Can be removed.

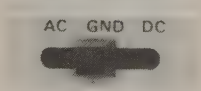
o Vertical axis:

CH1 (X) input ..... (21) Vertical input terminal of CH1. When in X-Y operation, X-axis input terminal.

CH2 (Y) input ..... (14) Vertical input terminal of CH2. When in X-Y operation, Y-axis input terminal.

CH3 (HOR) input ..... (12) Vertical input terminal for CH3. When TIME/DIV switch (39) is set in the [CH3|HOR] position, this terminal becomes the horizontal axis input terminal.

AC-GND-DC ..... (13) (20) Switch for selecting connection mode between input signal and vertical amplifier.

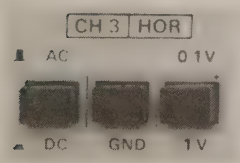


AC: AC coupling

GND: Vertical amplifier input is grounded and input terminals are disconnected.

DC: DC coupling

..... (9) (10) (11) Select input coupling and sensitivity of CH3.



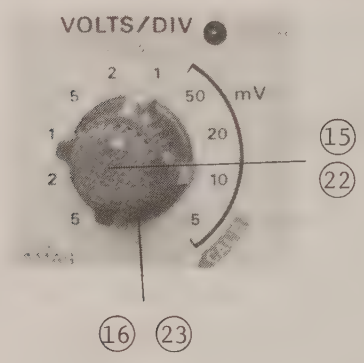
AC/DC: Selects coupling of input signal to CH3 amplifier between AC coupling and DC coupling.

GND: Grounds CH3 amplifier input signal and opens the input terminal.

0.1 V/1V: Selects CH3 amplifier sensitivity between 0.1 V/DIV and 1 V/DIV.

VOLTS/DIV ..... ⑯ ㉓ Select the vertical axis sensitivity, from 5 mV/DIV to 5 V/DIV with 10 ranges.

VARIABLE ..... ⑮ ㉒ Fine adjustment of sensitivity, with a factor of 1/2,5 or over of panel-indicated value. When in the CAL'D position, sensitivity is calibrated to panel-indicated value. When not in the CAL'D position, the UNCAL lamp ⑱ or ㉕ turns on.



When this knob is pulled out, the amplifier sensitivity is multiplied by 5 times.

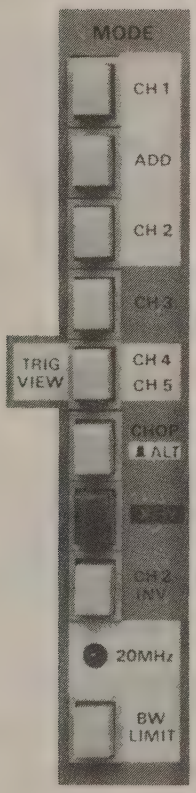
POSITION ..... ⑰ ㉔ Vertical positioning control of trace or spot.

When in X-Y operation, knob ㉔ is for horizontal positioning.

MODE ..... ㉖ Select vertical axis operation modes and frequency bandwidth limit function. Any combination of CH1, ADD (CH1 + CH2), CH2, CH3 and TRIG VIEW can be simultaneously displayed. The functions of the buttons as they are depressed are as follows:

CH1: CH1 signal is displayed.

ADD: Sum signal (CH1 + CH2) is displayed.



CH2: CH2 signal is displayed.

CH3: CH3 signal is displayed.

TRIG VIEW (CH4, CH5): By depressing the TRIG VIEW button it is possible to look at either A TRIG VIEW (CH4) or B TRIG VIEW (CH5). Both TRIG VIEW A and TRIG VIEW B can be viewed at the same time if the B TRIG SOURCE switch is set in the INT or EXT (÷10) position.

CHOP ALT: Selects switching mode when in multichannel operation.

: Alternate mode

: Chopping mode

X-Y: Oscilloscope operates as an X-Y scope, with CH1 for X-axis and CH2 for Y-axis. This button has the highest priority over all other buttons.

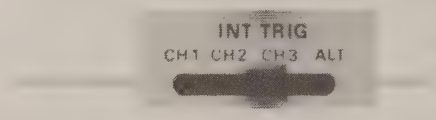
CH2: Polarity of CH2 signal is inverted.

INV: The up state is for normal polarity and the depressed state is for inverted polarity.

BW LIMIT: Limits the bandwidth of the vertical amplifier to approximately 20 MHz, cutting off the frequency components higher than this limit.

o Triggering

INT TRIG ..... (19)



Selects the internal trigger signal source. The signal selected by this switch is fed to the A trigger circuit if SOURCE switch (35) is set in the INT state or to the B trigger circuit if SOURCE switch (48) on rear panel is set in the INT state.

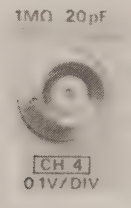
CH1: Input signal of CH1 is used as trigger signal.

CH2: Input signal of CH2 is used as trigger signal.

CH3: Input signal of CH3 is used as trigger signal.

ALT: Asynchronous signals on CH1, CH2 and CH3 may be viewed simultaneously using the INT TRIG ALT mode. (For details, see Subsection 4.6.)

External trigger (CH4).. (36)
Input terminal

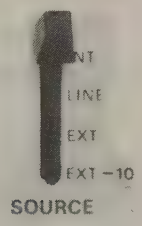


This terminal is used for both the CH4 input signal and the external trigger signal for the A trigger circuit. For the external trigger operation, set the SOURCE switch (33) in the EXT or the EXT ÷ 10 position.

External trigger (CH5) .. (46) This terminal is used for both the CH5 input signal and the external trigger signal for the B trigger circuit. For the external trigger operation, set the SOURCE switch (48) in the EXT or the EXT ÷ 10 position.

Input terminal

SOURCE ..... (35) This switch is used to select the trigger signal source for the A trigger circuit. The signal selected by this switch is used directly as the input signal of the TRIG VIEW (CH4).



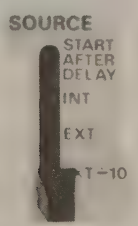
INT: Internal signal selected by INT TRIG switch (19) is used as trigger signal.

LINE: AC line signal is used as trigger signal.

EXT: Input signal of external trigger (CH4) input terminal (36) is used as trigger signal.

EXT ÷ 10: Input signal of external trigger (CH4) input terminal (36) is attenuated to 1/10 and used as trigger signal.

SOURCE ..... (48) Selects between continuous delay and triggered delay; selects the trigger signal source for the B trigger circuit.



START AFTER DELAY:
Selects the continuous delay mode independent of the B trigger signal.

The B sweep starts immediately after the period determened by DELAY TIME switch (39) and DELAY TIME MULTI switch (47) has elapsed.

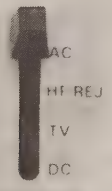
If this switch is set in any other position, the B sweep operates in the triggered delay mode, and it starts when the sweep delay time has elapsed after the B trigger signal has been applied.

INT: Internal trigger signal selected by INT TRIG switch (19) is used as trigger signal.

EXT: Input signal of external trigger (CH5) input terminal (46) is used as trigger signal.

EXT ÷ 10: Input signal of external trigger (CH5) input terminal (46) is attenuated to 1/10 and used as trigger signal.

COUPLING ..... (34) (49) Select coupling modes between trigger signal sources and trigger circuits;

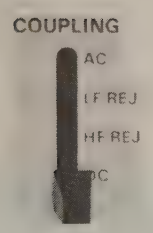


COUPLING

AC: AC coupling

LF REJ: AC coupling, with components lower than 50 Hz rejected.

HF REJ: AC coupling, with components higher than 50 Hz rejected.



DC: DC coupling

TV: The sweep circuit is connected to the TV sync separator circuit and the sweeps are triggered with TV V or TV H signal at a rate selected by the A TIME/DIV switch (39)

TV V: 0.5 sec/DIV - 0.1 msec/DIV
TV H: 0.5 µsec/DIV - 20 nsec/DIV.

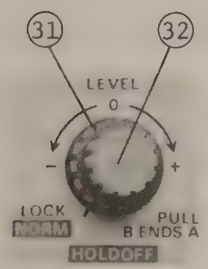
SLOPE ..... (33) (50) Selects the triggering slope.

"+": Triggering occurs when the trigger signal crosses the trigger level in positive-going direction.

"–": Triggering occurs when the trigger signal crosses the trigger level in negative-going direction.

HOLDOFF ..... (31)
LEVEL ..... (32)

These double-knob controls are for holdoff time adjustment and trigger level adjustment. The pulled out position of the LEVEL knob is for the B END'S A mode.



The HOLDOFF time control is used when the signal waveform is complex and stable triggering cannot be attained with LEVEL knob (32) alone.

The LEVEL knob is for displaying a synchronized stationary waveform and setting a start point for the waveform.

As this knob is turned in "→+" direction, the trigger level moves upward on the displayed waveform; as the knob is turned "-←", the level moves downward.

When set in the LOCK position, the trigger level is automatically maintained at an optimal value irrespective of the signal amplitude and for most signals requires no manual adjustment of the trigger level. When the signal level is at the trigger level, the TRIG'D LED (37) turns on.

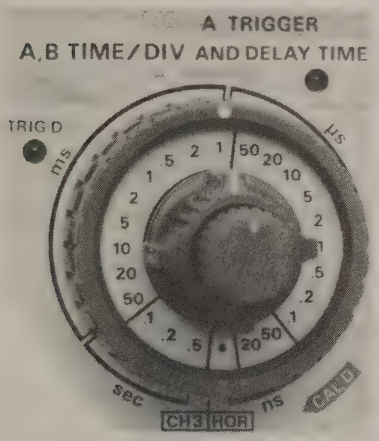
When in the B END'S A mode, the A sweep ends at the same time the B sweep ends. With this function, degradation of brightness can be minimized when in the delayed sweep mode with large magnification of waveform in the horizontal direction.

LEVEL..... (51)
TRACE SEP ..... (52)

These double-knob controls are for level adjustment and trace separation adjustment. The functions of the LEVEL knob (51) are the same as those of the LEVEL knob (32). The function of the TRACE SEP knob is to control the vertical distance between A sweep and B sweep when in the ALT sweep mode.

o Time Base

A, B TIME/DIV ..... (39)
AND DELAY TIME (40)



The large knob (39) is for A TIME/DIV and DELAY TIME, and the medium knob (40) is for B TIME/DIV.

The A TIME/DIV knob sets the A sweep rate; the DELAY TIME knob sets the delayed sweep rate.

The B TIME/DIV switch sets the delayed sweep (B sweep) time.

When the TIME/DIV switch is set in the DH3 | HOR position, the oscilloscope operates as a multichannel X-Y scope with CH3 channel as the X axis and other channels as the Y axis. (For details, see page 49.)

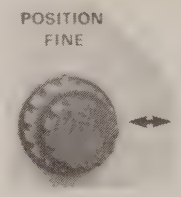
A VARIABLE ..... (41)
PULL ×10 MAG

For continuously variable adjustment of A sweep rate and for ×10 MAG function.

The value indicated by A TIME/DIV switch can be reduced by a factor of 2.5 or more. When set in the CAL'D position, the sweep speed is calibrated to the value indicated by the A TIME/DIV switch. When not in the CAL'D position, the UNCAL lamp (38) turns on.

When the knob is pulled out, the A or B sweep is expanded by 10 times.

POSITION ..... (44)
FINE (45)

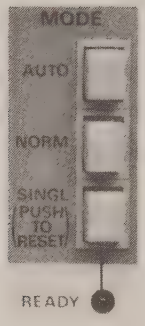


For horizontal positioning of spot or trace. The larger knob is for coase adjustment and the smaller for fine adjustment.

DELAY TIME ..... (47)
MULTI

Multi-turn potentiometer for continuously variable adjustment of the delay time indicated by the A sweep knob (39) in order to select the section to be expanded of the A sweep.

SWEEP MODE ..... (30)



Selects the desired sweep mode.

AUTO: When no triggering signal is applied or when triggering signal frequency is less than 50 Hz, sweep runs in the free mode.

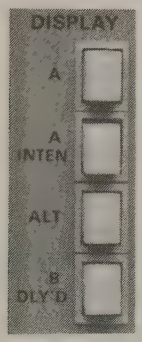
NORM: When no triggering signal is applied, sweep is in a ready state and the trace is blanked out. Used primarily for observation of signals of 50 Hz or lower.

SINGLE: PUSH TO RESET — Used for single sweep operation (one-shot sweep operation) in conjunction with the reset switch.

When the three buttons are in the pushed out state, the circuit is in the single sweep mode. The circuit is reset as

this button is pressed. When the circuit is reset, the READY lamp (42) turns on. The lamp goes off when the single sweep operation is over.

DISPLAY ..... (29) Selects A and B sweep mode as follows:



A: Main sweep (A sweep) mode for general waveform observation.

A INTEN: This sweep mode is used when selecting the section of the A sweep to be magnified for delayed sweep. The B sweep section (delayed sweep) is displayed with high brightness.

ALT: A INTEN sweep and B sweep (delayed sweep) are displayed alternately. (The A, B TRACE SEPARATION control (52) adjusts the distance between these traces.)

B: Displays the delayed sweep (B sweep) alone.

o Others

CAL (Vp-p) ..... (43) These terminals deliver the calibration voltage of approximately 1 kHz, positive square wave.

200 mV: Delivers 200 mVp-p signal. Output resistance approximately 200 Ω.

2 V: Delivers 2 Vp-p signal. Output resistance is approximately 2 kΩ.

..... (53) Ground terminal of oscilloscope mainframe.

4.2 Explanation of Rear Panel (See Figure 4-2.)

o Z Axis

A AXIS INPUT ..... (54) Input terminals for external intensity modulation signal.

o Output Terminals

CH1 SIGNAL OUTPUT ... (55) Delivers the CH1 signal with a voltage of approximately 10 mV per 1 DIV on screen (when terminated with 50 ohms). May be used for frequency counting, etc.

A GATE OUTPUT ..... (56) Delivers the A sweep gate signal. Output resistance is approximately 50 Ω.

A SWEEP OUTPUT ..... (57) Delivers the A sweep waveform signal. Output resistance is approximately 10 kΩ.

o Vertical Axes

CH4 POSITION ..... (59) Vertical positioning of the spot or trace of CH4 (A TRIG VIEW).

CH5 POSITION ..... (60) Vertical positioning of the spot or trace of CH5 (B TRIG VIEW).

o AC Power Input Circuit

AC power input connector ..... (61)
Input connector of the AC power of the instrument. Connect the AC power cord (supplied) to this connector.

FUSE ..... (62) Fuse in the primary circuit of the power transformer. Fuse rating is as shown in Table (63)

AC voltage selecting connector ..... (64)
For selecting the AC voltage of the instrument.

AC voltage selector plug ..... (65)
For selecting the AC voltage of the instrument by aligning its arrowhead mark in the corresponding position as shown in Table (63)

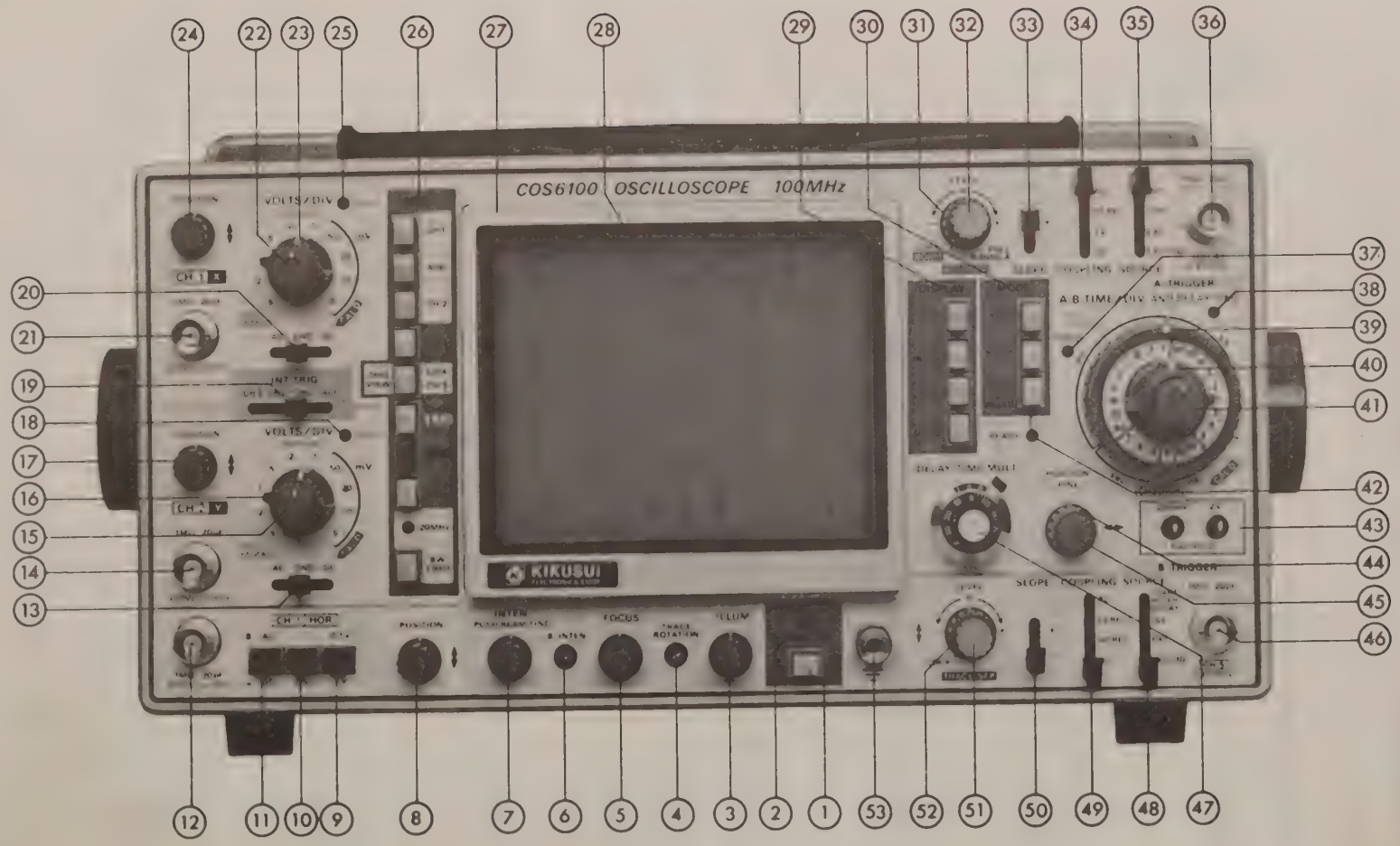

COS6100 OSCILLOSCOPE 100MHz
KIKUSUI
VOLTS/DIV
INT TRIG
POSITION
FOCUS
A TRIGGER
B TRIGGER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53

Figure 4-1

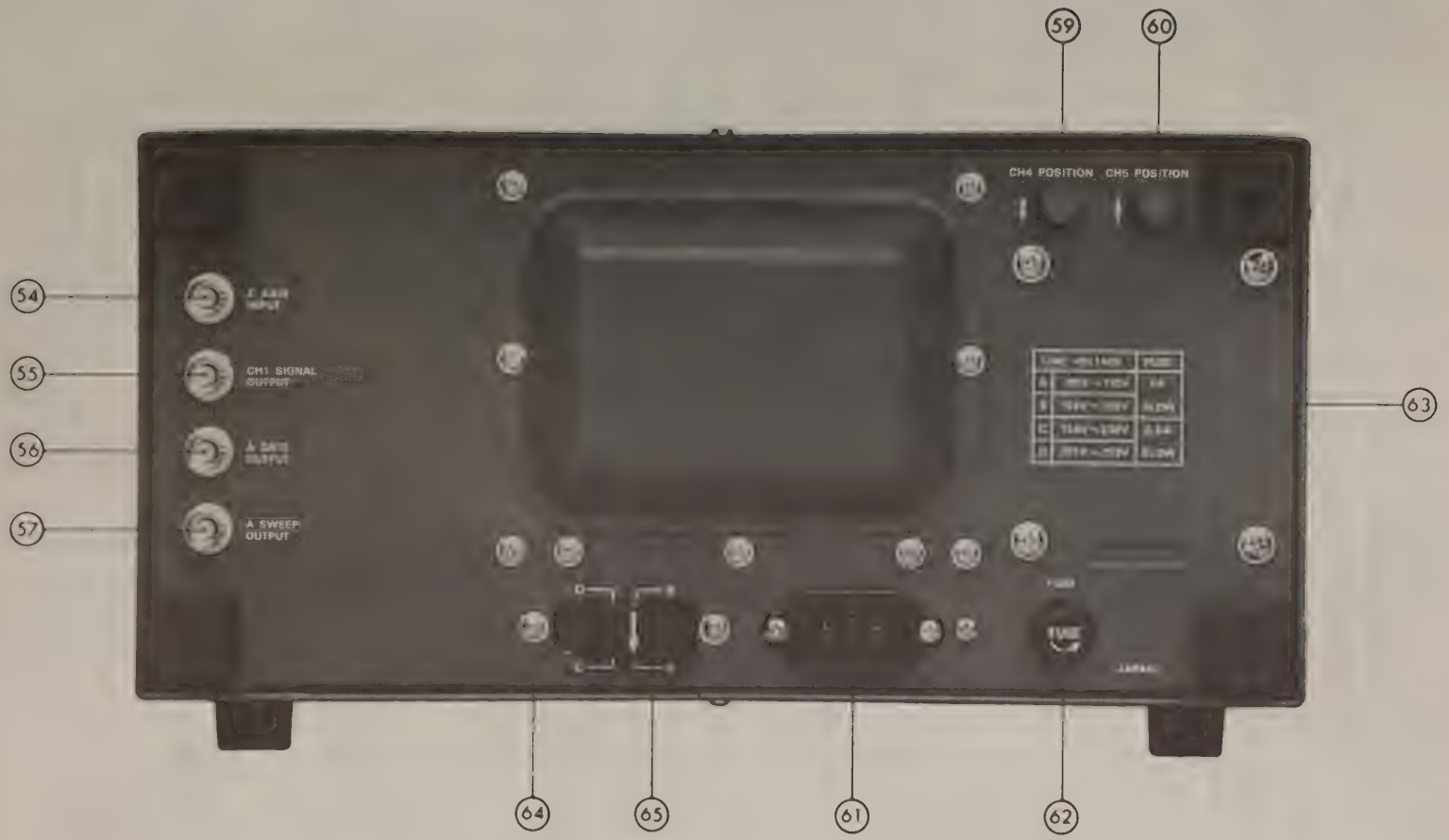

59
60
CH4 POSITION
CH5 POSITION
54
55
56
57
CH1 SIGNAL OUTPUT
A SWEEP OUTPUT
63
64
65
61
62

Figure 4-2

4.3 Basic Operation

Before connecting the power cord to an AC line outlet, check that the AC line voltage selector plug on the rear panel of the instrument is correctly set for the AC line voltage. After ensuring the voltage setting, set the switches and controls of the instrument as shown in the following table.

Item	No.	Setting
POWER	①	OFF position
INTEN	⑦	Clockwise (3-o'clock position)
FOCUS	⑤	Mid-position
ILLUM	③	Counterclockwise position
MODE (VERT)	㉖	All buttons in OUT state
↕ POSITION	⑧ ⑰ ㉔ ㊾ ㊿	Mid-position Mid-position (on rear panel)
VOLTS/DIV	⑯ ㉓	50 mV
VARIABLE (5 MAG)	⑮ ㉒	CAL'D (clockwise position) Depressed state
AC-GND-DC	⑬ ⑳	GND
AC/DC /GND	⑪ ⑩	AC ON
0.1V/1V	⑨	0.1V
INT TRIG	⑲	ALT
SOURCE	㉟ ㊽	INT START AFTER DELAY
COUPLING	㉞ ㊾	AC
SLOPE	㉝ ㊿	+
LEVEL	㉜ ㊶	LOCK (counterclockwise)

Item	No.	Setting
HOLDOFF	(31)	NORM (counterclockwise)
↕ TRACE SEP	(52)	Mid-position
MODE (SWEEP)	(30)	AUTO
DISPLAY	(29)	A
A, B TIME/DIV	(39) (40)	0.5 msec
VARIABLE	(41)	CAL'D (~~counterclockwise~~ clockwise)
×10 MAG		Depressed state
←→ POSITION	(44)	Mid-position
(FINE)	(45)	Mid-position

After setting the switches and controls as above, connect the power cord to the AC line outlet and, then, proceed as follows:

1) Turn-ON the POWER switch and make sure that the power pilot LED above is turned on. In about 20 seconds, a trace will appear on the CRT screen. If no trace appears in about 60 seconds,verify the switch and control settings as shown in the above table.

2) Adjust the trace to an appropriate brightness and sharpest image with the INTEN control and FOCUS control.

3) Align the trace with the horizontal center line of graticule by adjusting the CH1 POSITION control and TRACE ROTATION control (screwdriver adjust).

4) Connect the 961 BNC probe (supplied) to the CH1 INPUT terminal, and apply the 200 mVp-p CALIBRATOR signal to the probe tip.

5) Set the AC-GND-DC switch in the AC state. A waveform as shown in Figure 4-3 will be displayed on the CRT screen.

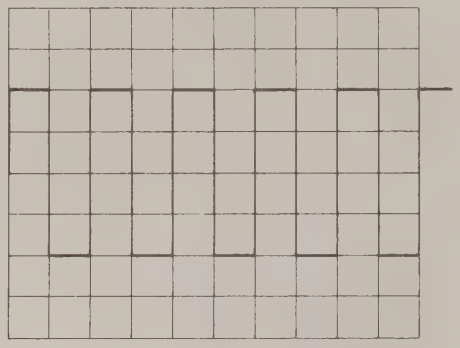


Figure 4-3

6) Adjust the FOCUS control so that the trace image becomes sharpest. No re-adjustment will be necessary as the linear focus circuit will automatically maintain the image in this best focussed state.

7) For signal observation, set the VOLTS/DIV switch and TIME/DIV switch in appropriate positions so that the signal waveform is displayed with an appropriate amplitude and an appropriate number of peaks.

8) Adjust the ↕ POSITION and ↔ POSITION controls in appropriate positions so that the displayed waveform is aligned with the graticule and the voltage (Vp-p) and period (T) can be read conveniently.

The above is the basic operating procedure of the oscilloscope. Further operation methods are explained in the subsequent paragraphs.

4.4 Vertical Mode Switches

The vertical mode switches of the oscilloscope are comprised of five types of mode selector switches as shown in the following:

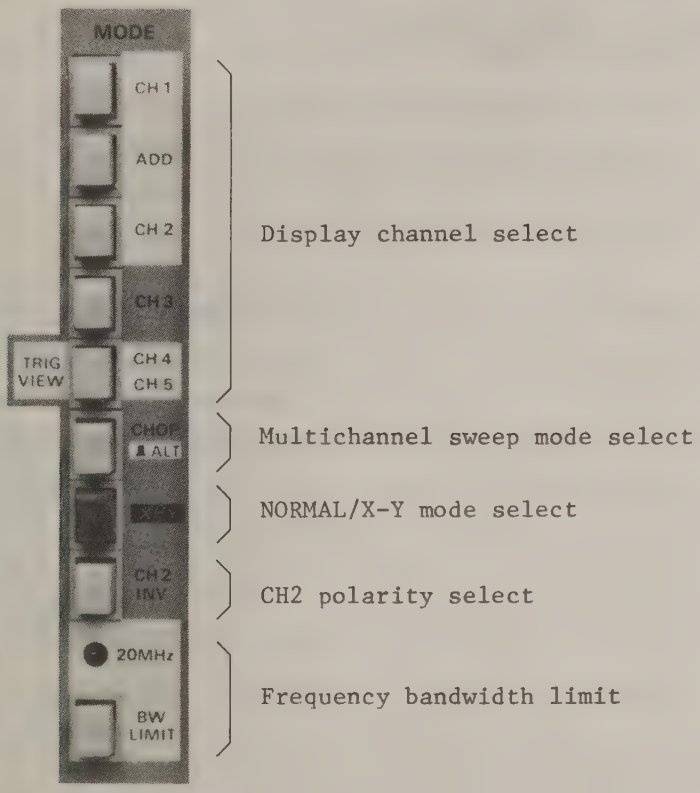


Figure 4-4

These mode switches can be set in any combination.

(1) Single-channel operation

For the signal-channel operation, depress one of the display channel buttons (⎍) and leave the remaining display channel buttons extended (⎍). If none of the display channel buttons are depressed (⎍), CH1 signal is displayed.

Note: Either CH1, ADD (CH1 + CH2), CH2, CH3, or TRIG VIEW (CH4) can be viewed independently of each other. TRIG VIEW (CH5) may not be viewed independently of CH4.

(2) Multichannel operation

For multichannel operation, depress only the required display channel buttons and leave all other vertical mode buttons extended. Set the CHOP/ALT button in the CHOP or ALT mode as required.

When in the CHOP mode, the channel signals are chopped in sequence at a rate of about 1 μsec (1 MHz). Multichannel traces are simultaneously displayed in a time-slicing method. When signal frequencies are high, the waveforms may be displayed with dotted lines. In such cases the ALT mode should be used.

When in the ALT mode, one channel is displayed for an entire sweep, then the next channel is displayed for an entire sweep. This mode is used primarily for display of high frequency signals at fast sweep speeds. At very low sweep speeds, signals are displayed alternately. In such cases the CHOP mode should be used.

Note: The multichannel operation can be done with any combinations of CH1, ADD (CH1 + CH2), CH2, CH3, and TRIG VIEW (CH4 and CH5). The last item means that the CH5 channel can be displayed only when the CH4 (TRIG VIEW) display is selected. The CH5 channel is displayed when the SOURCE switch (48) is set in the INT, EXT, or EXT (÷10) position.

(3) X-Y operation

Simply by depressing the [X-Y] button, the oscilloscope operates as an X-Y scope. This button has the highest priority over all other vertical mode selector buttons. The X-Y operation is with CH1 as X axis and CH2 as Y axis. The bandwidth of the X axis is DC to 5 MHz (-3 dB) and the CH1 POSITION control (24) is used as the X axis (↔) POSITION control. Other electrical performances remain the same as when the circuit is used as the CH1 vertical channel. The Y axis operates with the same electrical performances as when the circuit is used as the CH2 vertical channel, and its operation method remains the same.

When the calibration voltage signal is applied to the input terminals of both X and Y axis with the 961BNC Probes (supplied) and the corresponding VOLTS/DIV switches are properly adjusted, a Lissajous figure as shown in Figure 4-5 will be displayed.

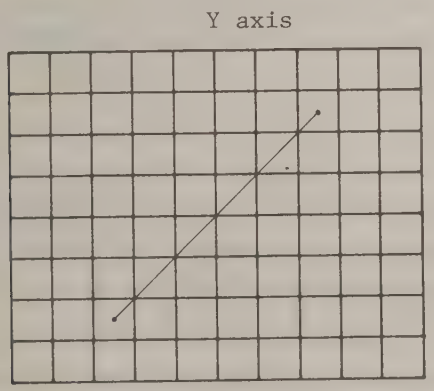


Figure 4-5

Note: When high frequency signals are displayed in the X-Y operation, pay attention to the frequency bandwidths of and phase difference between X and Y axes.

(4) ADD operation

An algebraic sum of the CH1 and CH2 signals can be displayed on the screen by depressing the ADD switch. The displayed signal is the difference between CH1 and CH2 signals if the CH2 POLARITY switch is set in the INV (⊓) state.

For accurate addition or subtraction, it is a prerequisite that the sensitivities of the two channels are adjusted accurately to the same value. Vertical positioning can be done with the ↕ POSITION knob of either channel. In view of the linearities of the vertical amplifiers, it is most advantageous to set them in their mid-positions.

(5) BW LIMIT mode

When the BW LIMIT button is depressed (⊓), a bandpass filter of approximately 20 MHz is inserted in the vertical amplifier. When in this mode of operation, higher frequency components and noise components are eliminated from the displayed signal. Another advantage of this mode is that the internal noise components are eliminated and consequently a clear waveform is displayed. This mode is suitable for use at lower frequencies.

4.5 CH3 HOR Operation

When the A TIME/DIV switch is set in the CH3 | HOR position, the oscilloscope operates as a multichannel X-Y scope with the channels (except CH3) selected by the vertical mode switches as the Y axis and CH3 as the X axis. The bandwidth of the X axis becomes DC - 5 MHz (-3 dB). The vertical (↕) POSITION knob (8) can be used as the horizontal (↔) POSITION knob. Other electrical performances are the same as CH3. Regarding the Y axis, the channels selected by the vertical mode switches are displayed in the CHOP mode, with the electrical performances and the operation method remaining the same.

4.6 Triggering

Proper triggering is essential for efficient operation of an oscilloscope. The user of the oscilloscope must make himself thoroughly familiar with the triggering functions and procedures.

(1) Functions of INT TRIG (internal trigger) switch:

The signals applied to the input terminals of CH1, CH2 and CH3 are picked off from respective preamplifiers in order to be used as internal trigger signals. The INT TRIG switch selects these signals. The selected signals are sent to the A trigger circuit or the B trigger circuit through the SOURCE switch. The relationships of these circuits are shown in the block diagram of Figure 4-6.

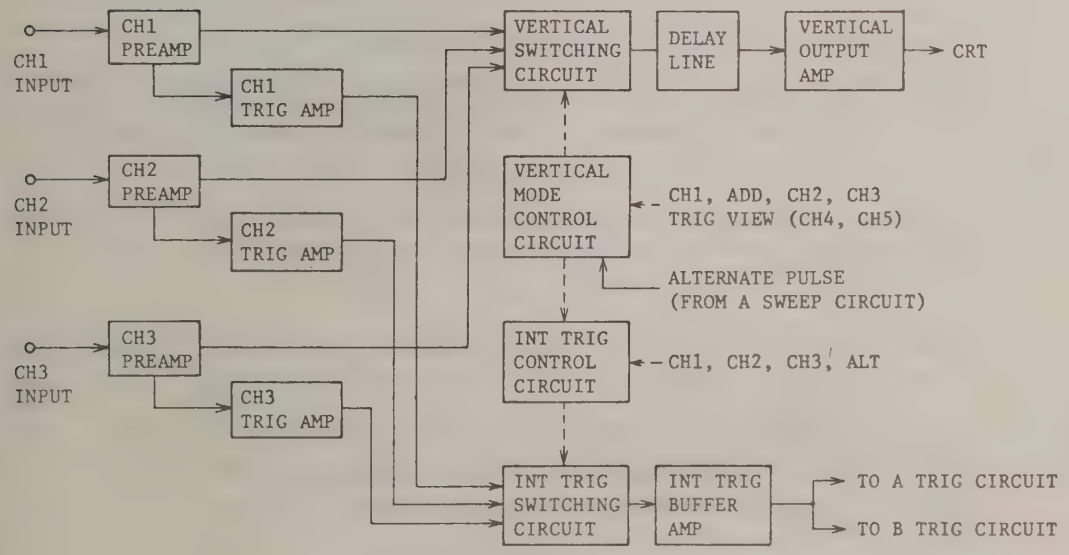


Figure 4-6

With the INT TRIG switch the internal trigger signal can be selected as follows.

CH1: Input signal of CH1
CH2: Input signal of CH2
CH3: Input signal of CH3
ALT: All signals being displayed on screen

As can be seen in the block diagram, the triggering circuits are designed with certain relationships to the vertical mode selector switches. These relationships are shown in the following table.

INT TRIG \ MODE	CH1	ADD	CH2	CH3	TRIG VIEW	
					CH4	CH5
CH1	Trig by CH1					
CH2	Trig by CH2					
CH3	Trig by CH3					
ALT	Trig by CH1	Trig by CH1	Trig by CH2	Trig by CH3	(Trig by CH1)	(Trig by CH1)

The items enclosed in the parentheses are for the TRIG VIEW (INT TRIG) mode.

Notes: When in the ALT mode, two or more signals of CH1, CH2, and CH3 use the same trigger circuit alternately. Therefore, these signals must cross the same trigger level. Pay attention to the DC components of these signals.

Note that jitter may be produced when the sweep speed is slow if the SOURCE switch is set for AC coupling.

The ALT trigger function for vertical modes is effective only when in the single-channel operation and when in the ALT-mode multichannel operation. It is not effective when in the CHOP node.

(2) Function of SOURCE Switch:

To display a stationary pattern on the CRT screen, the displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit. The SOURCE switch selects such a trigger source.

INT: This internal trigger method is used most commonly. The signal applied to the vertical input terminal (the measured signal) is branched off from a point in the amplifier circuit and is fed to the trigger circuit through the INT TRIG switch. Since the trigger signal is the measured signal itself, a very stable waveform can be readily displayed on the CRT screen.

LINE: The AC power line frequency signal is used as the trigger signal. This method is effective when the measured signal has a relationship with the AC line frequency, especially for measurements of low level AC noise of audio circuits, thyristor circuits, etc.

EXT: The sweep is triggered with an external signal applied to the external trigger input terminal (CH4 or CH5). An external signal which has a periodic relationship with respect to the measured signal is used. Since the measured signal (vertical input signal) is not used as the trigger signal, the waveform display can be done independent of the measured signal. (Select CH4 or CH5 input signal.)

EXT ÷ 10: The external trigger signal applied to the external trigger input terminal is attenuated into 1/10 before being applied to the trigger circuit. Operation is the same with those of the EXT trigger mode. This mode is used when the external trigger signal level is too high.

START AFTER DELAY: This position is for continuous sweep delay (B sweep) mode. When in other position (INT or INT ÷ 10), the sweep runs in the triggered delay mode. (When in the START AFTER DELAY position, the CH5 signal is not displayed if the vertical mode selector switch is set in the TRIG VIEW position.)

(3) Functions of COUPLING switch:

This switch is used to select the coupling of the trigger signal to the trigger circuit in accordance with the characteristics of the measured signal.

AC: This coupling is for AC triggering which is used most commonly. As the trigger signal is applied to the trigger circuit through an AC coupling circuit, stable triggering can be attained without being affected by the DC component of the input signal. The low-range cut off frequency is 3 Hz (-3 dB).

When the ALT trigger mode is used and the sweep speed is slow, jitter may be produced. In such a case, use the DC mode.

LF REJ: The trigger signal is fed to the trigger circuit through an AC coupling circuit and a high pass filter (approximately 50 kHz, -3 dB). The DC component, AC noise and other low frequency components are rejected. Only the higher frequency components of the trigger signal are applied to the trigger circuit.

HF REJ: The trigger signal is fed to the trigger circuit through an AC coupling circuit and a low pass filter (approximately 50 kHz, -3 dB). The higher frequency components of the trigger signal are rejected. Only the lower frequency components of the trigger signal are applied to the trigger circuit.

TV: This coupling is triggering of TV video signals. The trigger signal is AC-coupled and fed via the trigger circuit (level circuit) to the TV sync separator circuit. The separator circuit picks off the sync signal, which is used to trigger the sweep. Thus, the video signal can be displayed very stably.

Being linked to the TIME/DIV switch, the sweep speed is switched for TV.V and TV.H as follows:

TV.V: 0.5 sec - 0.1 msec
TV.H: 50 µsec - 20 nsec

The SLOPE switch should be set in conformity with the video signal as shown in Figure 4-7.

Figure 4-7

DC: The trigger signal is DC-coupled to the trigger circuit. This mode is used when triggering on a DC component of a signal or when triggering on very low frequency signals.

(4) Functions of SLOPE switch:

This switch selects the slope (polarity) of the trigger signal.

"+": When set in the "+" state, triggering occurs as the trigger signal crosses the trigger level in the positive-going direction.

"-": When set in the "-" state, triggering occurs as the trigger signal crosses the trigger level in the negative-going direction.

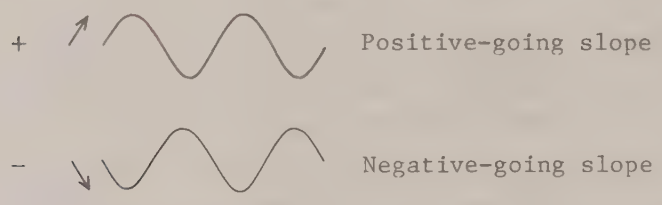


Figure 4-8

(5) Functions of LEVEL (LOCK) control:

The function of this control is to adjust the trigger level and display a stationary image. At the instant the trigger signal has crossed the trigger level set by this control, the sweep is triggered and a waveform is displayed on the screen.

The trigger level changes in the positive direction (upward) as this control knob is turned clockwise and it changes in the negative direction (downward) as the knob is turned counterclockwise. The rate of change is set as shown in Figure 4-9.

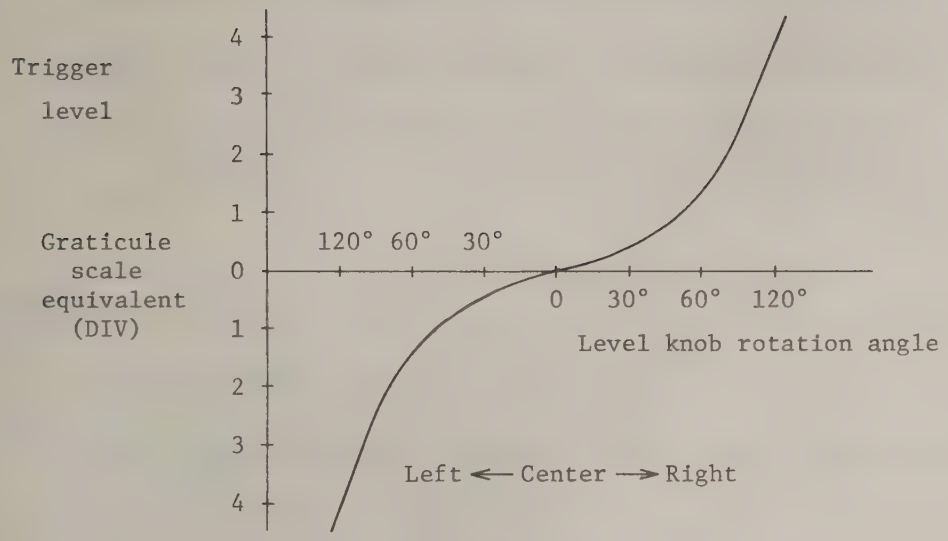


Figure 4-9

o LEVEL LOCK

When the LEVEL knob is set in the LEVEL LOCK position, the trigger level is automatically maintained within the amplitude of the trigger signal and stable triggering can be done without requiring level adjustment (although jitter may not be suppressed when in the ALT mode). This automatic level lock function is effective when the signal amplitude on the screen or the external trigger input voltage is within the following range:

50 Hz - 20 MHz: 0.9 DIV (0.09 V) or less
50 Hz - 100 MHz: 1.5 DIV (0.15 V) or less

(6) Functions of A HOLD OFF control:

When the measured signal is a complex waveform with two or more repetition frequencies (periods), triggering with the above-mentioned LEVEL control alone may not be sufficient

for attaining a stable waveform display. In such a case, the sweep can be stably synchronized to the measured signal waveform by adjusting the HOLD OFF time (sweep pause time) of the sweep waveform. The control covers at least the time of one full sweep, for sweeps faster than 0.2 sec/DIV.

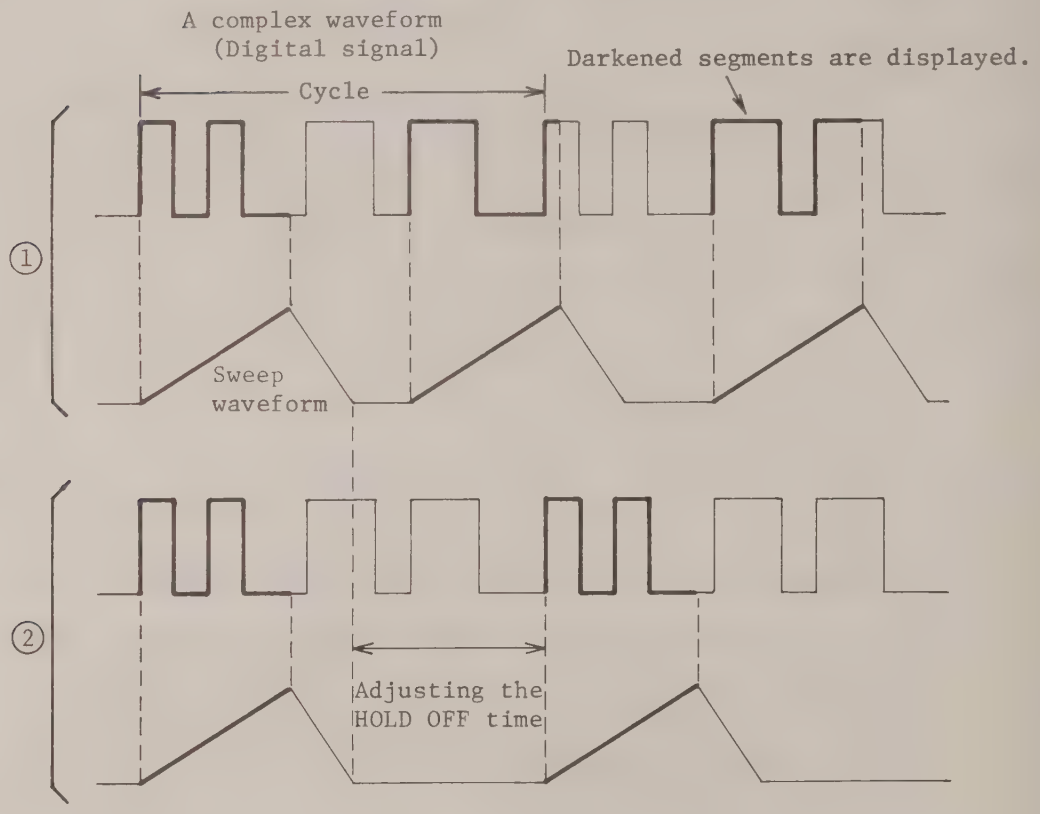


Figure 4-10

Figure 4-10 ① shows a case where the HOLD OFF knob is in the NORM state and various different waveforms are overlapped on the screen, making the signal observation unsuccessful.

Figure 4-10 ② shows a case where the undesirable portion of the signal is with held and the same waveforms are displayed on the screen.

4.7 Single-sweep Operation

Non-repetitive signals and one-shot transiential signals can hardly be observed on the screen. Such signals can be measured by displaying them in the single-sweep mode on the screen and photographing them.

- Measurement of non-repetitive signal:

  (1) Set the DISPLAY in the "A" state and the SWEEP MODE in the NORM state.

  (2) Apply the measured signal to the vertical input terminal and adjust the trigger level.

  (3) Set the SWEEP MODE in the SINGLE state (the three push-button switches are up).

  (4) Press the RESET button. The sweep will run only for one cycle and the measured signal will be displayed only once on the screen.

- Measurement of one-shot signal:

  (1) Set the DISPLAY in the "A" state and the SWEEP MODE in the NORM state.

  (2) Apply the calibration output signal to the vertical input terminal, and adjust the trigger level to a value corresponding to the predicted amplitude of the measured signal.

  (3) Set the SWEEP MODE in the SINGLE state. Apply the measured signal instead of the calibration signal to the vertical input terminal.

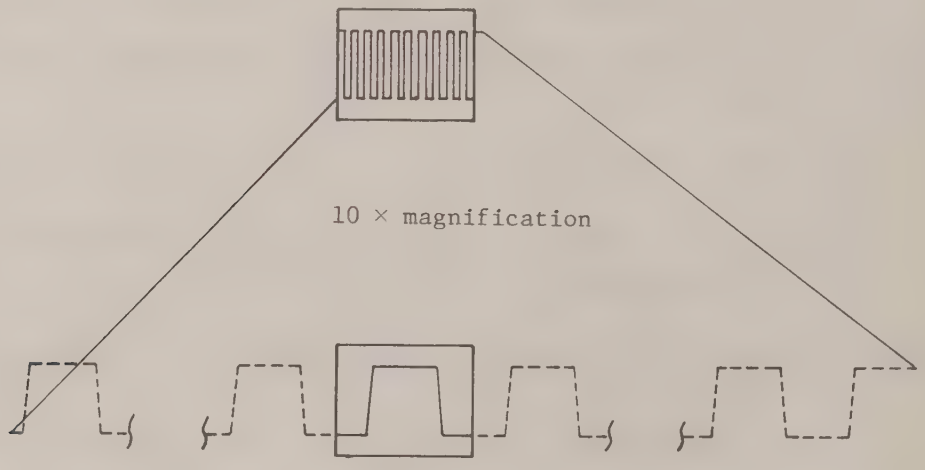
  (4) Depress the RESET button. The sweep circuit will become the ready state and the READY lamp will turn on.

(5) As the one-shot signal occurs in the input circuit, the sweep runs only for one cycle and the one-shot signal is displayed on the CRT screen.

The single-sweep operation can be done also with A INTEN B sweep. However, it cannot be done in the multichannel ALT mode operation. For multichannel one-sweep operation, use the CHOP mode.

4.8 Sweep Magnification

When a certain part of the displayed waveform needs to be magnified, a faster sweep speed (MAG) may be used. In such a case, pull out the sweep VARIABLE knob 41 (set in the ×10 MAG state). When this is done, the displayed waveform is expanded by 10 times. The center of the waveform will be displayed. Any part can be covered by means of POSITION control.



Any part can be covered by means of POSITION control.

Figure 4-11

When the sweep is magnified and the sweep speed has become faster than 20 nsec/DIV, the trace intensity may be reduced. In such a case, the displayed waveform should be expanded in the B sweep mode explained in the subsequent paragraphs.

4.9 Waveform Magnification with Delayed Sweep

With sweep magnification (described above), the magnification ratio is limited to 10×. With the delayed sweep method, the sweep can be expanded for a wide range of from several times to several thousand times depending on ratio between A sweep time and B sweep time.

As the measured signal frequency becomes high and the A sweep range for the non-expanded signal becomes higher, the available expansion ratio becomes smaller. Furthermore, as the magnification ratio becomes larger, the trace intensity becomes lower and the delay jitter increases. To cope with this situation, a triggered delay circuit and a B ENDS A circuit are provided.

(1) Continuous delay:

Set the DISPLAY switch to A and display the signal waveform with the A sweep in the regular operation method.

Next, set the B TIME/DIV switch to a position faster than that of the A TIME/DIV switch.

After ensuring that the SOURCE switch (48) is set in the START AFTER DELAY state, turn the DISPLAY switch to the A INTEN position. A part of the displayed waveform will be accentuated as shown in Figure 4-12, indicating the state ready for delayed sweep. The intensified portion denotes the section corresponding to the B sweep time (DELAYED SWEEP).

The period from the start of the A sweep to the beginning of B sweep (the accentuated portion of the trace) is called "SWEEP DELAY TIME". This period is continuously variable by means of the DELAY TIME MULTI dial.

Next, change the DISPLAY switch to the B position. The B sweep time will be expanded to a full sweep (10 cm) as shown in Figure 4-13.

The B sweep time is set by the B TIME/DIV switch and the magnification ratio becomes as follows:

$$\text{Magnification ratio} = \frac{\text{A TIME/DIV indication}}{\text{B TIME/DIV indication}}$$

The sweep delay time can be read on the CRT screen. For more accurate determination, the DELAY TIME MULTI dial should be used.

$$\text{Sweep delay time} = \text{A TIME/DIV indication} \times \text{DELAY TIME MULTI dial setting}$$

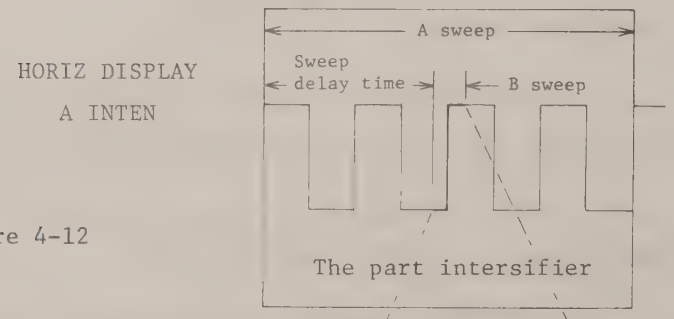


Figure 4-12

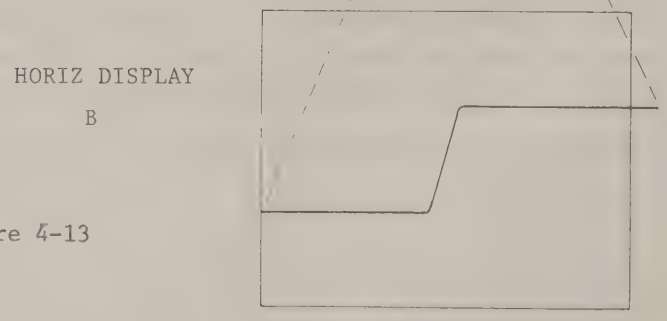


Figure 4-13

(2) Triggered delay:

When the displayed waveform is magnified by 100 times or more by the continuous delay method, delay jitter is produced. To suppress the jitter, a triggered delay method may be used.

For this operation, the B trigger circuit operates when the SOURCE switch (48) is set in the INT state and the B sweep is triggered by the B trigger pulse. Therefore, even when the delay time is continuously varied by rotating the DELAY TIME MULTI dial, the starting point does not vary continuously but varies intermittently. This operation when in the A INTEN mode can be observed as the intensified section jumps from trigger point to trigger point on the A sweep waveform.

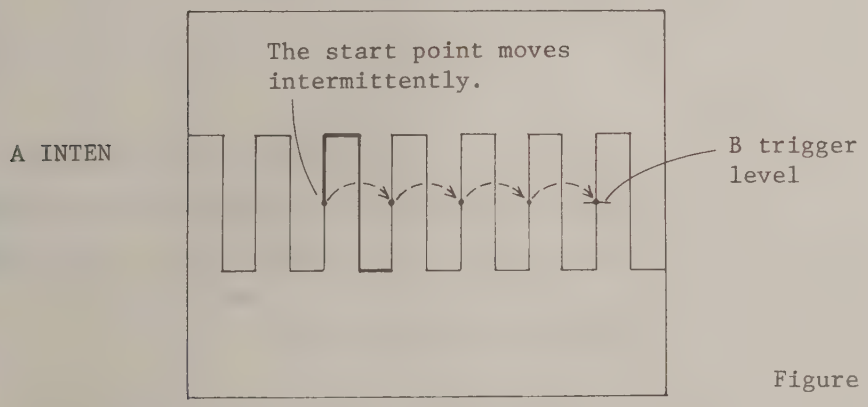


Figure 4-14

4.10 Delayed ALT Sweep

When in the Delayed ALT sweep mode, the A sweep and B sweep (delayed sweep) are displayed alternately on the screen, enabling you to observe at the same time the unmagnified waveform and magnified section.

To prevent the two waveforms from overlapping and to display them separately, adjusted the TRACE SEP control (52).

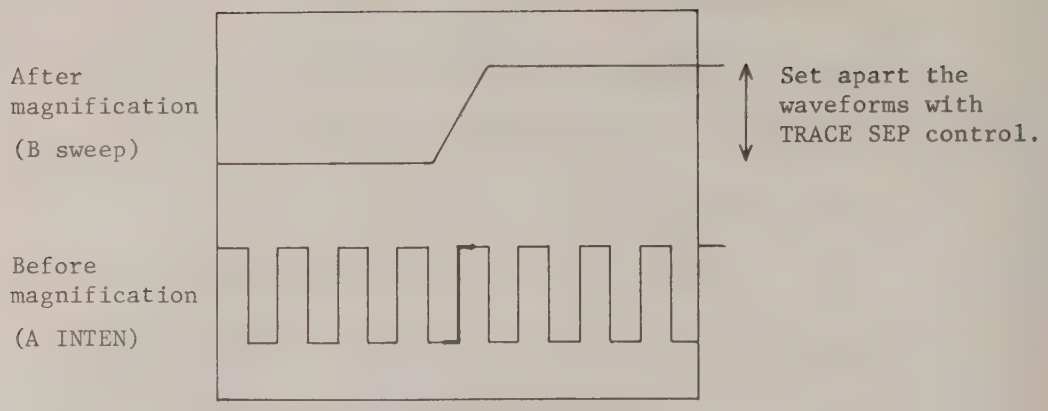


Figure 4-15

Note: The delayed ALT sweep mode can be used in combination with the multichannel mode (CHOP or ALT) of the vertical axes.

4.11 B ENDS A Mode

When the trace is magnified by a large ratio with the delayed sweep, the magnified trace may become dim and hardly discernible. By ending the A sweep at the minimum required point, the display time for the B sweep is increased so that the trace does not become dim. The B ENDS A mode should be used.

The operating method is the same as that of Subsections 4.9 and 4.10. Pull out the LEVEL knob (32) to set it in the B END A state, and a bright magnified trace shown in Figure 4-16 will be displayed.

Turn the A HOLD OFF knob (31) to the extreme clockwise position (B ENDS A position). A bright magnified trace as shown in Figure 4-16 will be displayed.

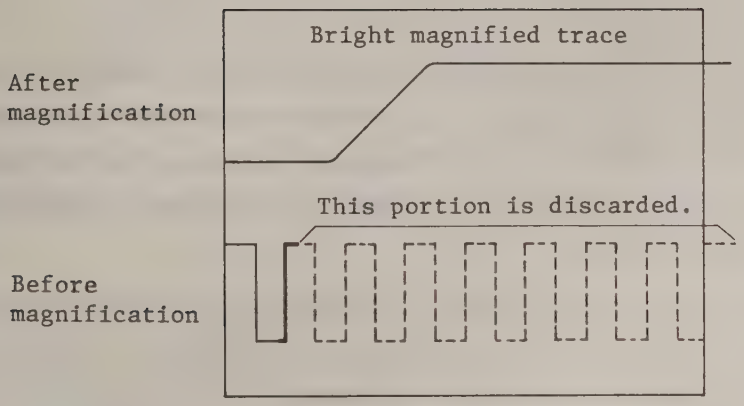

Bright magnified trace
After magnification
This portion is discarded.
Before magnification

Figure 4-16

5. MEASURING METHODS

5.1 Connection Method of Input Signal

The input impedance of the oscilloscope as viewed from the vertical input terminal is 1 MΩ with capacitance approximately 20 pF in parallel. When the probe 10:1 is used, the impedance increases to resistance 10 MΩ with capacitance approximately 12 pF in parallel.

There are various methods of connecting the signal sources to the oscilloscope. The most popular methods are with regular covered wires, with shielded wires, with a probe, or with a coaxial cable. The following factors should be considered.

Output impedance of input signal source
Level and frequency of input signal
External induction
Distance between the input signal source and the oscilloscope

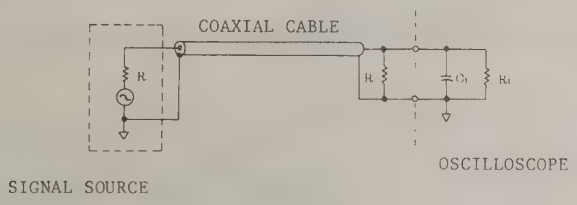
Types of input signals and connection methods are tabulated in the following:

Type of input signal \ Connection method			Probe	Coaxial cable
Low frequency	Low impedance	Near	◯	◯
		Far		◯
	High impedance	Near	◯	▨
		Far		▨
High frequency	Low impedance	Near	◯	◯
		Far		◯
	High impedance	Near	◯	▨
		Far		

(◯: Good, ▨: Fair)

o Connection with coaxial cable:

When the output impedance of the signal source is 50Ω or 75Ω, the input signal can be fed without attenuation by using a coaxial cable which enables impedance matching.
For impedance matching, terminate the coaxial cable with a 50Ω or 75Ω pure-resistive resistor corresponding to the characteristic impedance of coaxial cable, as shown in Figure 5-1.

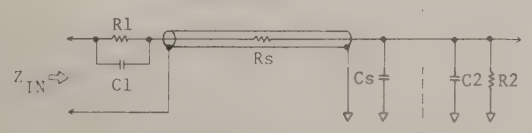


R = R'
When R = 50 Ω, use a 50 Ω coaxial cable.
When R = 75 Ω, use a 75 Ω coaxial cable.

Figure 5-1

o Connection with probe:

Two probes with an attenuation ratio of 10:1 are supplied. The probe circuit and probe cable are shielded to prevent induction noise. The probe circuit makes up a wide-range attenuator in conjunction with the input circuit of the oscilloscope, thereby enabling a distortionless connection from DC to high frequencies. When the probe is used, although the signal level is attenuated to 1/10, the input impedance becomes very high (resistance 10 MΩ, capacitance approx. 13 pF) and the loading effect on the measured signal source is greatly reduced as explained in the following.



Rs = Series resistance of cable
Cs = Stray capacitance plus cable capacitance

Figure 5-2

The probe makes up an attenuator with resistor R1, in the probe, and the input resistor R2, in the oscilloscope. Capacitor C1 compensates for input capacitor C2 in the oscilloscope and stray capacitance (Cs) in the cable. The input impedance Z_{IN} is expressed as follows:

$$Z_{IN} = \frac{R1 + R2}{\omega C\ (R1 + R2) + 1}$$

$$C = \frac{C1 \times (C2 + Cs)}{C1 + C2 + Cs}$$

Attenuation ratio A is expressed as follows:

$$A = \frac{R2}{R1 + R2} \quad \left(= \frac{1\ M\Omega}{9\ M\Omega + 1\ M\Omega} = \frac{1}{10} \right)$$

The terms enclosed in the parentheses are for the factor when the probe is used:

Precautions:

- o Observe the maximum allowable input voltages mentioned in Section 3.5.
- o Do not fail to use the ground lead supplied.
- o Before taking measurement, accurately adjust the frequency compensation of the probe without fail.
- o Do not apply large mechanical shocks or vibration to the probe. Do not sharply bend or strongly pull the probe cable.
- o The probe unit and tip are not highly heat resistant. Do not apply a soldering iron to a circuit close to the point where the probe is attached.

5.2 Voltage Measurement

To measure the AC portion of a signal which has DC superimposed on the AC component, set the vertical input AC/DC selector switches (13) and (20) in the AC position. To measure the DC component of a signal, set the switch in the DC position.

Before commencing voltage measurement, set the VARIABLE attenuator knobs (15) and (22) at the CAL'D position and calibrate the sensitivity to the value indicated by the VOLTS/DIV selector switches (16) and (23).

Apply the signal to be measured, display the signal with an appropriate amplitude on the screen, and determine the amplitude on the graticule. For DC voltage measurement, determine the shifted distance of the trace. The voltage can be determined as follows:

(1) When measured signal is directly applied to input terminal:

Voltage (V) = Deflection amplitude (DIV) × VOLTS/DIV

(2) When the 10:1 probe is used:

Voltage (V) = Deflection amplitude (DIV) × VOLTS/DIV × 10

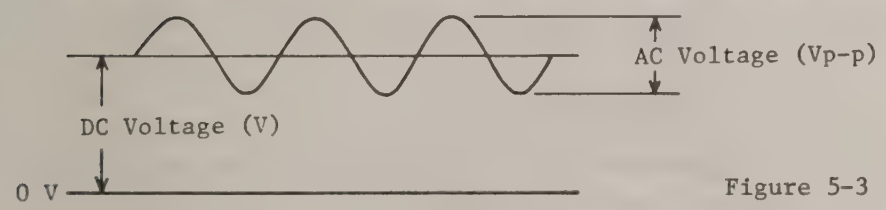


Figure 5-3

5.3 Current Measument (voltage drop method)

Connect a small resistor (R) in series in the circuit in which the current (I) to be measured flows and measure the voltage drop across the resistor with the oscilloscope. The current is known from Ohm's law as follows:

$$I = \frac{E}{R} \quad (A)$$

The resistance should be as small so possible it does not cause change to the measured signal source.

In the above method, currents from DC to high frequencies can be measured quite accurately. Note that the accuracy of the resistor reflects upon the measuring accuracy.

5.4 Time Measurement

Measurement of time interval

The time interval between any two points on the displayed waveform can be measured by setting the TIME/DIV VARIABLE knob (41) in the CAL'D position and referring to the indication of the TIME/DIV switch (39).

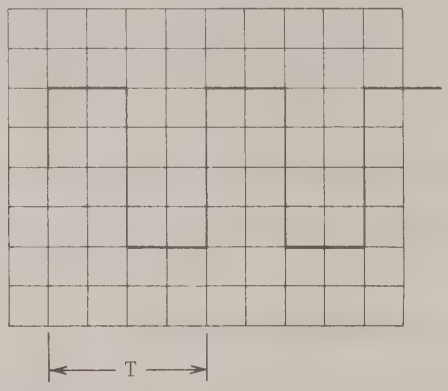


Figure 5-4

Time T (sec) = Indication of TIME DIV × Horizontal span (DIV)

When the sweep is magnified (×10 MAG (41) pulled), the time is 1/10 of the value determined as above.

5.5 Frequency Measurement

- Frequency measurement by determining time (T) per one cycle of the displayed waveform:

  Time T (period) is measured as explained in section 5.4 and the frequency is known by using the following formula.

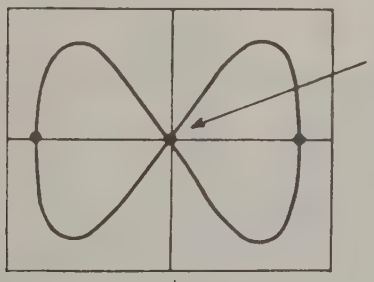
$$\text{Frequency } f \text{ (Hz)} = \frac{1}{\text{Period } T \text{ (sec)}}$$

- Frequency measurement with Lissajous figure (See Figure 5-5 and 5-6):

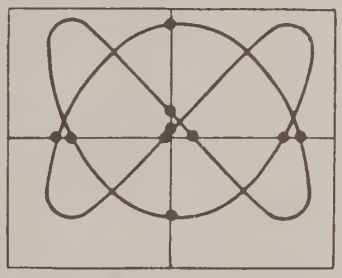
  Set the MODE switch (21) in the X-Y state so that the oscilloscope operates in the X-Y mode.

Apply to the X-axis a known frequency from a signal genetator (SG) and to the Y-axis the frequency to be measured. Adjust the required controls so that a pattern is displayed on the full surface of the CRT screen. Then adjust the frequency of the signal generator so that the displayed pattern becomes stationary as shown in Figure 5-4. From the displayed waveform, the unknown frequency can be calculated as follows:

$$\text{Unknown Frequency (Hz)} = \frac{\text{The number of crossing points over horizontal scale line}}{\text{The number of crossing points over vertical scale line}} \times \text{Frequency of signal generator (Hz)}$$



The number of crossing points is 2.



$$\frac{4}{2} = \frac{2\ (H)}{1\ (V)} \qquad \frac{6}{4} = \frac{3\ (H)}{2\ (V)}$$

Figure 5-5

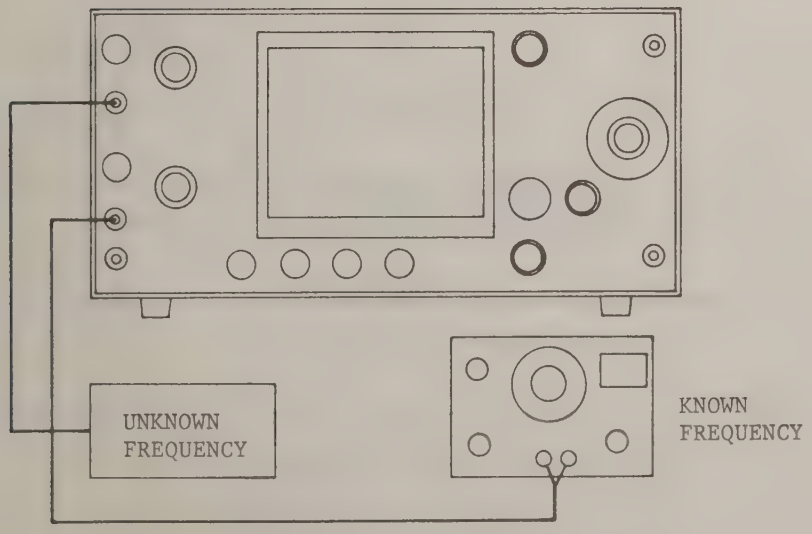


Figure 5-6

5.6 Measurement of Phase Difference

o Measurement of phase difference with Lissajous figure (See Figures 5-6, 5-7 and 5-8):

Operate the oscilloscope in the X-Y mode as explained in the paragraph for frequency measurement, and apply two signals of the same frequency (such as stereophonic signals) to the X and Y axes so that a Lissajous figure is displayed on the CRT screen. The phase difference between the two signals can be known by measuring the displayed waveform and employing the following equation:

$$\text{Phase difference } \theta = \sin^{-1} \frac{B}{A}$$

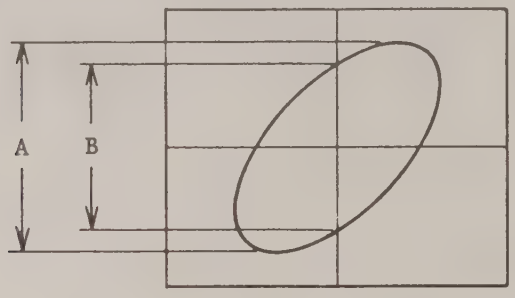


Figure 5-7

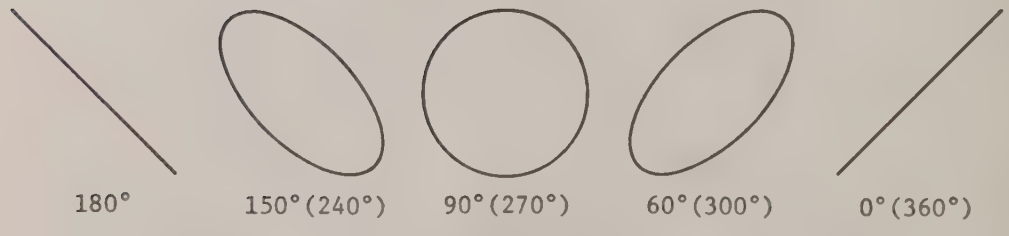


Figure 5-8

5.7 Characteristics of Pulse Waveform

A theoretically ideal pulse waveform is such that the signal changes instantaneously from one level to another, held in this level for a period of time and returns instantaneously to the original level. However, actual pulse waves are distorted. Nomenclature of distortions is given in Figure 5-9.

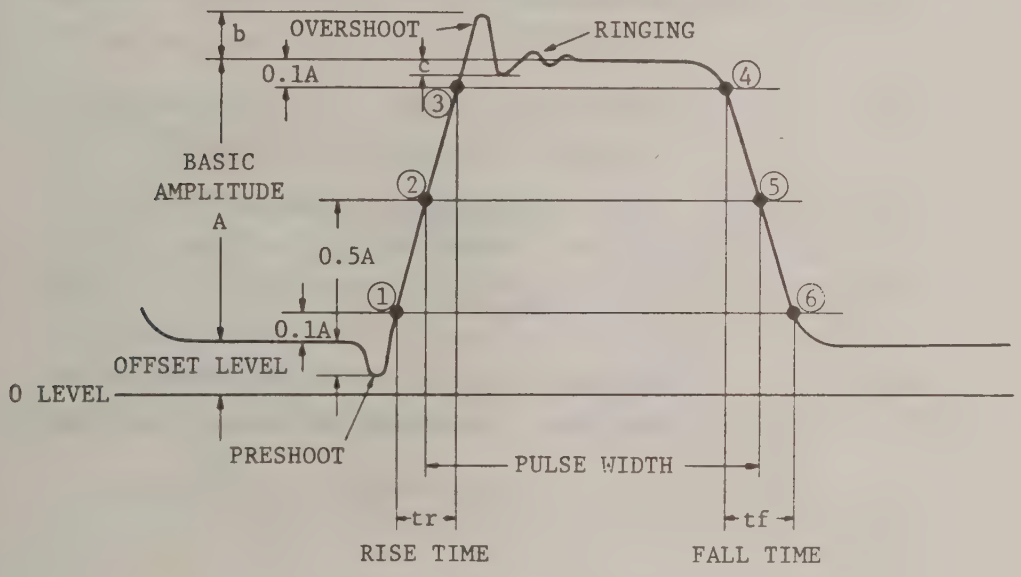


Figure 5-9

Pulse amplitude: Basic amplitude (A) of pulse

Pulse width: Time between points ② and ⑤ where signal amplitude is 50% of basic amplitude

Rise time: Time between 10% basic amplitude point ① and 90% basic amplitude point ③

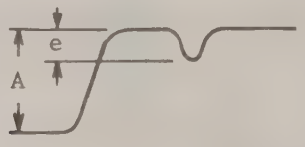
Fall time: Time between 90% basic amplitude point ④ and 10% basic amplitude point ⑥

Overshoot: Amplitude of the first maximum excursion beyond basic amplitude. Expressed in terms of b/A × 100 (%)

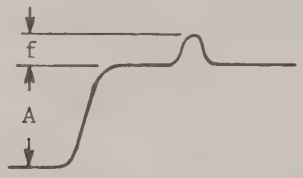
Ringing: Oscillation which follows the first maximum excursion. Expressed in terms of e/A × 100 (%)

Preshoot: Amplitude change (rise or fall) which precedes rise up of main pulse. Expressed in terms of e/A × 10 (%)

Hole: Amplitude fall that occurs after rise up of main pulse. Expressed in terms of c/A × 100 (%)



Bump: Amplitude rise that occurs after rise up of main pulse. Expressed in terms of c/A × 100 (%)



(Refer to MEA-25 or IFC PUB. 351-1.)

o Measurement of rise time:

The rise time of a pulse can be known by determining the value of t_r on the CRT screen in the method of "Time Measurement." It must be noted that t_r determined on the CRT screen includes the rise time of the oscilloscope itself. The closer the rise time of the oscilloscope (t_o) to the rise time of the measured pulse (t_n), the larger is the error introduced. To eliminate this error, calculation should be done as follows:

True rise time $t_n = \sqrt{(t_r)^2 - (t_o)^2}$

where, t_r: Rise time measured on CRT screen

t_o: Rise time of oscilloscope itself (approx. 3.5 nsec)

For example, when a pulse wave with a rise time of 10 nsec (about 3 times that of the oscilloscope) is measured on the CRT screen, the error is approximately 6%.

o Measurement of Sag

Pulse waveforms may have slanted sections as shown in Figure 5-10, in addition to those distortions mentioned in Figure 5-9. Slants are caused when the signal is amplified with an amplifier which has poor low-frequency characteristics, resulting from attenuation of low frequency components. The slanted section (d or d') is called "sag" and is calculated as follows:

$$\text{Sag} = \frac{d}{A} \quad (\text{or} \quad \frac{d'}{A'}) \times 100\ (\%)$$

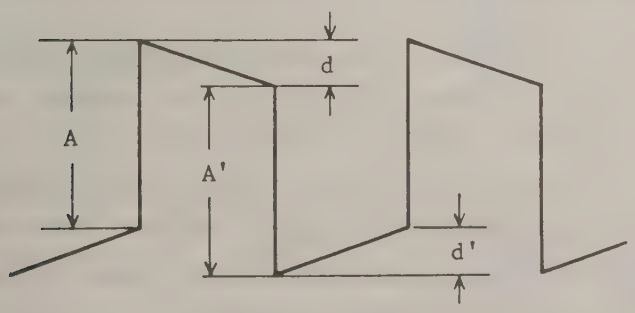


Figure 5-10

Note: If the AC-coupling mode is used for measurement of a low frequency pulse, sag is caused. For measurement of low frequency pulses, use always the DC-coupling mode.

6. CIRCUIT DESCRIPTION

6.1 General

The overall circuit structure of the oscilloscope is as depicted with a block diagram in Figure 6-1. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for moving the beam spot in the X-axis direction, a CRT circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

The vertical amplifier circuit has three mutually independent preamplifiers (CH1, CH2 and CH3), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stage. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals received from the CH1, CH2 and CH3 preamplifiers and the CH4 and CH5 signals received from the A & B trigger generators. The switched signal is fed via the horizontal switching circuit and delay line circuit to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the A & B trigger generators.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

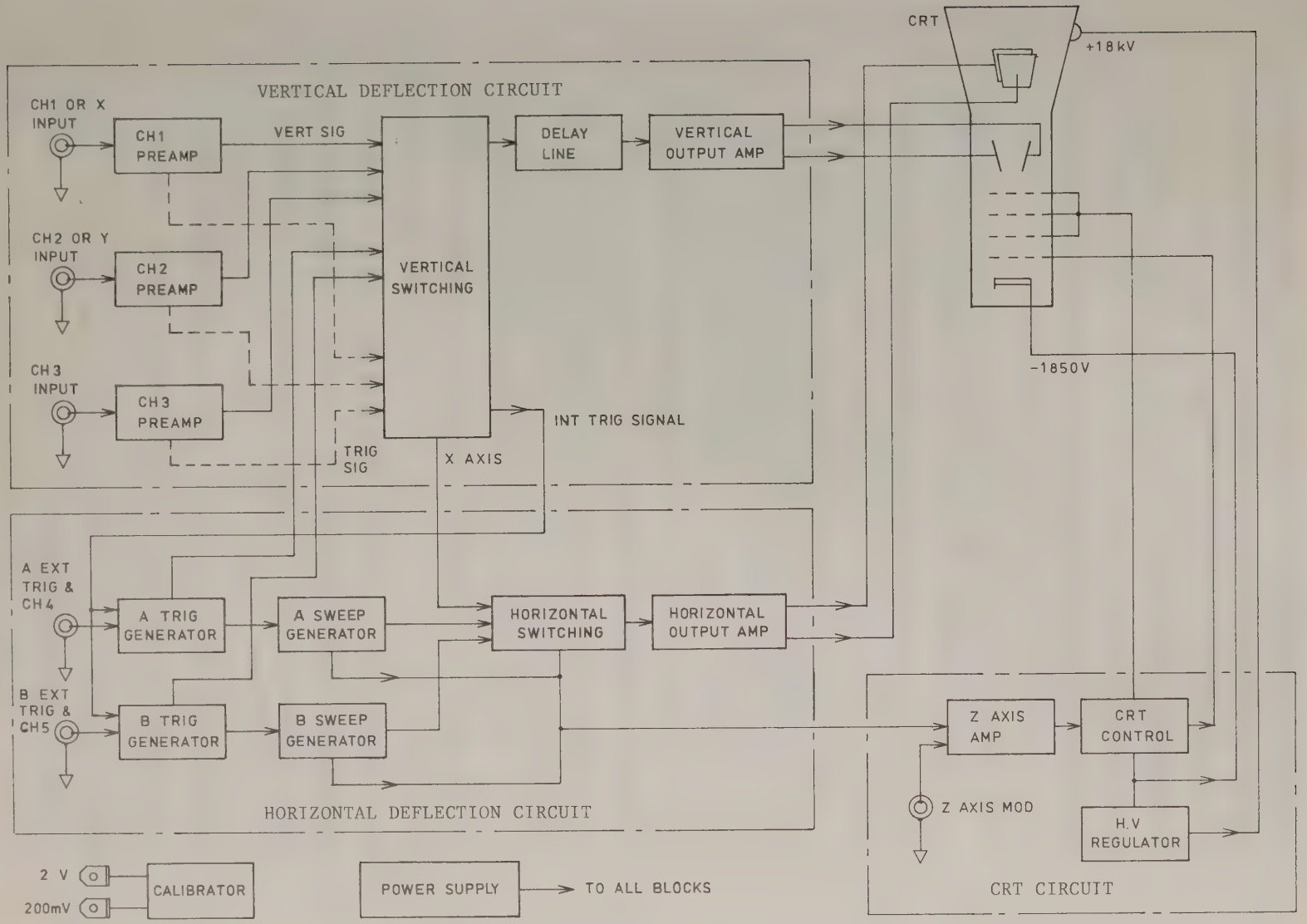

CRT
+18kV
VERTICAL DEFLECTION CIRCUIT
CH1 OR X INPUT
CH1 PREAMP
VERT SIG
DELAY LINE
VERTICAL OUTPUT AMP
CH2 OR Y INPUT
CH2 PREAMP
VERTICAL SWITCHING
CH3 INPUT
CH3 PREAMP
-1850V
INT TRIG SIGNAL
TRIG SIG
X AXIS
A EXT TRIG & CH4
A TRIG GENERATOR
A SWEEP GENERATOR
HORIZONTAL SWITCHING
HORIZONTAL OUTPUT AMP
B EXT TRIG & CH5
B TRIG GENERATOR
B SWEEP GENERATOR
Z AXIS AMP
CRT CONTROL
Z AXIS MOD
H.V REGULATOR
HORIZONTAL DEFLECTION CIRCUIT
CRT CIRCUIT
2 V
200mV
CALIBRATOR
POWER SUPPLY
TO ALL BLOCKS

Figure 6-1

The horizontal deflection circuit has mutually independent A and B trigger generators and sweep generators, a horizontal switching circuit, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical switching circuit or an external trigger signal from the EXT TRIG or CH4 or CH5 INPUT terminal and amplifies the signal and generates a trigger pulse signal.

The A sweep generator is driven by the trigger pulse signal of the A trigger generator and produces the A sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The B sweep generator produces the B sawtooth signal, being driven by the delayed sweep start signal produced with respect to the A sawtooth signal when in the delayed sweep mode. The B sweep generator can also be driven by the trigger pulse signal of the B trigger generator which follows the above delayed sweep start signal (the B TRIG'D mode).

The horizontal switching circuit electronically switches the sawtooth signals received from the A and B sweep generators and the CH1 & CH2 HOR signal received from the vertical switching circuit, and sends the resultant signal to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state.

The HV regulator provides a -1.8 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it and a 18 kV voltage which is used as a post-acceleration voltage to accelerate further the electrons after passing the vertical and horizontal deflection plates.

The Z-axis amplifier amplifies the unblanking signals received from the A and B sweep generators and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT circuit.

The CRT circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuit into levels suitable for application to the CRT.

6.2 Preamplifiers

The CH1 and CH2 preamplifiers amplify the signals of the CH1 (X-axis) and CH2 (Y-axis) input terminals, respectively. The CH3 preamplifier amplifies the signal applied to the CH3 or HOR input terminal. A detailed block diagram is shown in Figure 6-2.

- Input coupling switch:

The input coupling switch (S101, S201, S301-1, or S301-2) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

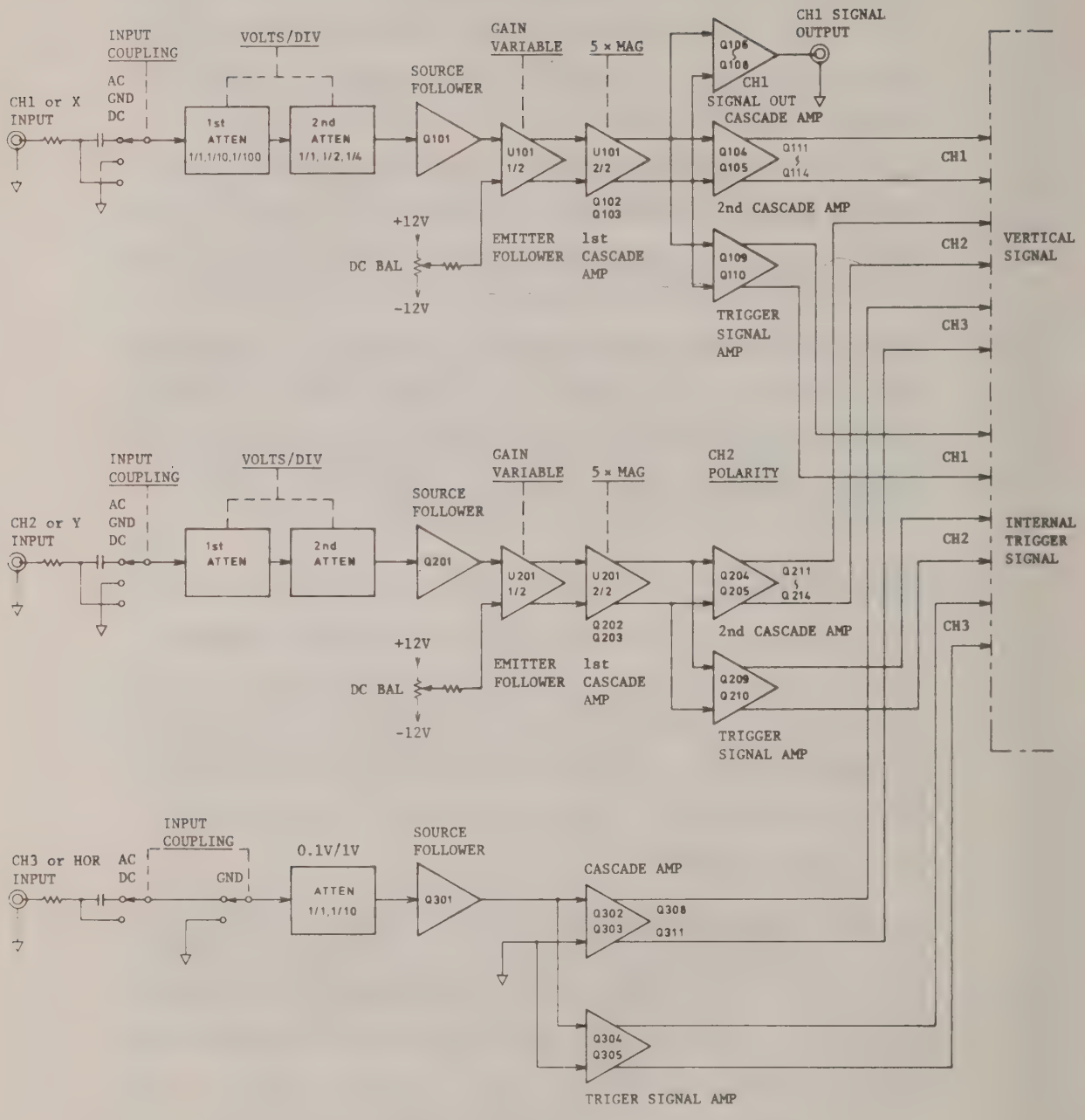

CH1 or X INPUT
INPUT COUPLING
AC
GND
DC
VOLTS/DIV
1st ATTEN 1/1,1/10,1/100
2nd ATTEN 1/1, 1/2, 1/4
SOURCE FOLLOWER
Q101
GAIN VARIABLE
5 × MAG
U101 1/2
U101 2/2
Q102
Q103
+12V
DC BAL
-12V
EMITTER FOLLOWER
1st CASCADE AMP
CH1 SIGNAL OUTPUT
Q106
Q108
CH1 SIGNAL OUT CASCADE AMP
Q104
Q105
Q111
Q114
2nd CASCADE AMP
Q109
Q110
TRIGGER SIGNAL AMP
CH1
CH2
CH3
VERTICAL SIGNAL
CH2 or Y INPUT
CH2 POLARITY
Q201
U201 1/2
U201 2/2
Q202
Q203
Q204
Q205
Q211
Q214
Q209
Q210
INTERNAL TRIGGER SIGNAL
CH3 or HOR INPUT
0.1V/1V
ATTEN 1/1,1/10
Q301
CASCADE AMP
Q302
Q303
Q308
Q311
Q304
Q305
TRIGER SIGNAL AMP

Figure 6-2

o Attenuators:

The CH1 or CH2 attenuator circuit consists of two attenuators: The 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By switching these attenuators with the VOLTS/DIV switch (SW102/202), the signal can be attenuated for a total range of 1/1 to 1/400 in 10 steps. The attenuator circuit is so designed that its input impedance remains constant at 1 MΩ, 20 pF (±2 pF) even when combinations are changed.

The CH3 attenuator provides an attenuation ratio of 1/10, thereby providing two ranges of 0.1 V/DIV and 1 V/DIV.

o Impedance converter:

The impedance converter presents with its source follower (Q101/Q201/Q203) a high input impedance to prevent the loading effect on the high-impedance attenuator circuit and provides a low output impedance with its emitter follower (CH1 and CH2) to drive the 1st differential cascade amplifier of the next stage. In order to guard against thermal drift, the source follower employs a dual-FET package which houses two thermally-coupled elements for thermal drift compensation and the emitter follower employs two premium-grade thermally-coupled transistors.

o 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter-connected differential current amplifier (U101-2/2, U202-2/2) and a current-to-voltage converter (Q102, 103/Q202, 203) which converts the differential collector output current of the differential current amplifier into a voltage signal. This amplifier also has the VARIABLE circuit for continuously-variable adjustment of the sensitivity between two adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the 5 × MAG switch for magnifying the vertical sensitivity by 5 times to realize the 1 mV/DIV sensitivity.

o VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer RV103/RV203 a part of the collector current amplified by U101-2/2 or U201-2/2. Adjustment (attenuation) can be done with a ratio of 1/2.5 or over.

o 5 × MAG circuit:

The 5 × MAG function is to increase the vertical sensitivity by 5 times by switching the output load resistor of the 1st differential cascade amplifier to the value of 5 times of that when in the normal mode.

o Buffer emitter follower:

The buffer (U101-1/2 or U201-2/2) has a function of sending, with less loading effects, the output signal of the preceding 1st differential cascade amplifier to the subsequent 2nd differential cascade amplifier, trigger signal pickoff amplifier, and CH1 SIGNAL OUTPUT amplifier (CH1 only).

o 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q104, 105, 111, 114, or Q204, 205, 211 - 214) amplifies the output of the emitter follower to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q111, 114/211 - 214) of this cascade amplifier has a function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the signal of the CH1 signal output amplifier. For the CH2 signal, this amplifier also has a function of inverting its polarity. This polarity inverting function is accomplished by switching with the INV switch (S351-8) the base grounding stages of Q211/214 and Q212/213 to which the collector currents which have been current-amplified by Q204 and Q205 are fed in a crossing manner.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd differential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace on the CRT screen is added to the output current signal of the 2nd differential cascade amplifier, being controlled by potentiometer RV108/208 of the positioning circuit.

- o CH1 signal output amplifier (CH1 only):

  The CH1 signal output amplifier (Q106, 107, 108) amplifies the input signal of the CH1 (X INPUT) terminal by approximately 5 times (2.5 times when terminated with 50 ohms). The amplified signal is fed to the output terminal (J12) on the instrument rear panel in order to be monitored with a frequency counter or other measuring instrument.

6.3 Vertical Switching Circuit

The vertical switching circuit is comprised of a vertical signal switching circuit which electronically switches the vertical signals received from the CH1, CH2 and CH3 preamplifiers and the CH4 and CH5 signals received from the A & B TRIG generators, an internal trigger signal switching circuit which electronically switches the trigger signals, and a switching logic circuit which controls these switching circuits.

The vertical signal switching circuit is, as shown in Figure 6-3, comprised of a diode gate circuit, an ADD BAL and buffer circuit which switches the vertical signals with the signal received from the switching logic circuit, and a switching buffer circuit which receives the signal from the diode gate.

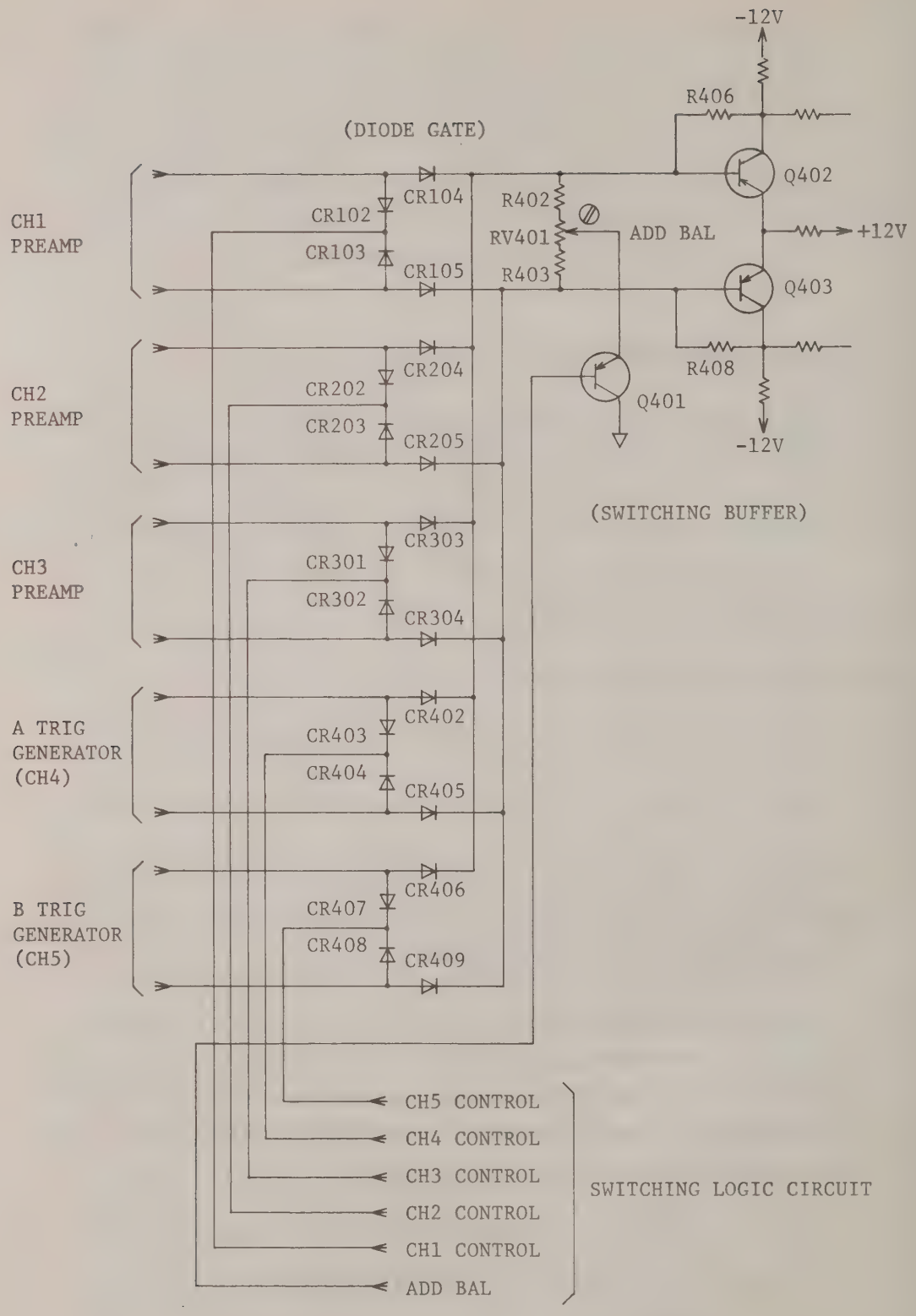

-12V
R406
(DIODE GATE)
Q402
CR104
R402
CR102
RV401
ADD BAL
+12V
CH1
PREAMP
CR103
CR105
R403
Q403
CR204
R408
CR202
Q401
CH2
PREAMP
CR203
CR205
-12V
(SWITCHING BUFFER)
CR303
CR301
CH3
PREAMP
CR302
CR304
CR402
CR403
A TRIG
GENERATOR
(CH4)
CR404
CR405
CR406
CR407
B TRIG
GENERATOR
(CH5)
CR408
CR409
CH5 CONTROL
CH4 CONTROL
CH3 CONTROL
CH2 CONTROL
CH1 CONTROL
ADD BAL
SWITCHING LOGIC CIRCUIT

Figure 6-3

o Diode gate circuit:

The diode gate circuit (CR102 - 105, CR202 - 205, CR301 - 304, CR402 - 409) selects the CH1 - CH5 signals being controlled by the signal of the switching logic circuit according to the mode selected by the VERT MODE switch (S351).

For example, when the VERT MODE switch is set at CH1, the CH1 control signal becomes the Hi state and the CH2 to CH5 control signals become Lo state. Consequently the output signal of the CH1 preamplifier is fed through CR104 and CR105 to the switching buffer circuit consisting of Q402 and Q403. The signals of the other channels are fed through respective diodes CR202/203, CR301/302, CR403/404 and CR407/408 to the control circuit. Thus, the signal of CH1 alone is fed to the switching buffer circuit and the signals of the remaining channels are blocked.

o ADD BAL circuit:

When the ADD mode is selected by the VERT MODE switch, the control signals of both CH1 and CH2 becomes the Hi state, the signals of the CH1 and CH2 preamplifiers are fed through CR104/105 and CR204/205 to the switching buffer circuit, and the two signals are fed as their sum signal to the output circuit. The function of the ADD BAL circuit is to compensate for the DC balance shift caused by the above addition operation, with its ADD BAL control (semi-fixed potentiometer RV401).

o Internal trigger switching circuit:

The internal trigger switching circuit directly controls, with the control signal from the switching logic circuit, the diode gate circuit (CR351 - 362) which is similar to the vertical signal switching circuit. It receives with its switching buffer (Q351/352) the trigger signal which has passed the diode gate circuit and feeds the signal to the internal trigger output amplifier. The internal trigger output amplifier (Q353/354)

coverts the output signal of the switching circuit into a low impedance signal which is delivered as the internal trigger signal via connector P-31.

o Switching logic circuit:

The switching logic circuit is comprised of a vertical switching logic circuit which controls the vertical switching circuit and an internal trigger switching logic circuit which controls the internal trigger switching circuit.

The vertical switching logic circuit is comprised of a ring counter which is consisting of three flip-flops (U307, U309-2/2) with preset/clear terminals and a code converter (U304, U305) which receives the ring counter output and generates control signals for individual channels. Switching can be done for any combination of channels by turning on and off the preset/reset terminals of the ring counter. The code-converted control signal is fed to the internal trigger switching logic circuit.

The internal trigger switching logic circuit controls the internal trigger switching circuit by switching with IC U301 the control signal selected by the INT TRIG switch (S301) and the control signal received from the vertical switching logic circuit. This relationship is shown in the following table.

INT TRIG \ MODE	CH1	ADD	CH2	CH3	TRIG VIEW	
					CH4	CH5
CH1	Triggered by CH1					
CH2	Triggered by CH2					
CH3	Triggered by CH3					
ALT	Trig'd by CH1	Trig'd by CH1	Trig'd by CH2	Trig'd by CH3	(Trig'd by CH1)	(Trig'd by CH1)

The items enclosed in the parentheses are for the case of TRIG VIEW (INT TRIG).

6.4 Delay Line Circuit

The vertical input signal is fed via the vertical switching circuit to the bandwidth filter circuit and then to the delay line drive circuit.

The bandwidth filter circuit consists of a CR filter (R412/C405 and R414/C406) and a transistor (Q404) which turns on and off the filter. With the control signal of the BW LIMIT switch (S351-9), bandwidth can be selected between 20 MHz and full band.

The vertical signal which has passed the bandwidth filter is amplified by the delay line drive circuit (Q405, Q406). The delay line drive circuit drives the delay line, with a matched output impedance.

The delay line is used to prevent the trigger point of the signal from being lost from being displayed on the screen due to time lag in the horizontal deflection circuits or the Z-axis amplifier circuits. For the delay line, this oscilloscope employs a delay cable which provides a delay time of approximately 90 nanoseconds. The vertical signal which has passed the delay line is fed to the vertical output amplifier.

6.5 Vertical Output Amplifier

The vertical output amplifier is comprised of a delay line receiver which receives the output signal of the delay line with a matched impedance, an A & B trace separation circuit which positions the B sweep waveform when in the ALT mode, an emitter follower circuit which converts the output of the delay line receiver into a sufficiently low impedance to drive the final cascade amplifier which drives the vertical deflection plates of the CRT, and an X-Y alignment circuit which adjusts the right-angle feature of the displayed axes. A schematic diagram of the vertical output amplifier is shown in Figure 6-4.

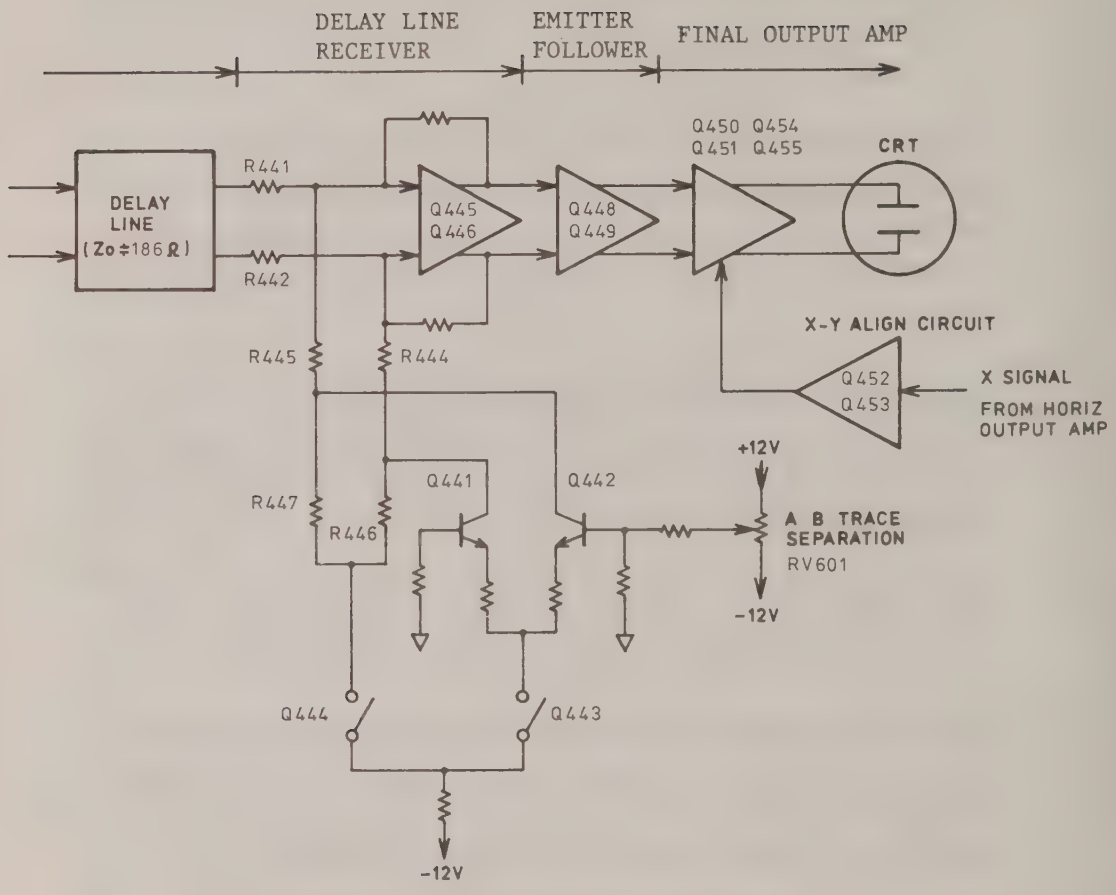

DELAY LINE RECEIVER
EMITTER FOLLOWER
FINAL OUTPUT AMP
DELAY LINE (Zo≒186Ω)
R441
R442
Q445 Q446
Q448 Q449
Q450 Q454 Q451 Q455
CRT
X-Y ALIGN CIRCUIT
Q452 Q453
X SIGNAL FROM HORIZ OUTPUT AMP
R445
R444
+12V
Q441
Q442
R447
R446
A B TRACE SEPARATION RV601
-12V
Q444
Q443
-12V

Figure 6-4

o Delay line receiver circuit:

The delay line receiver circuit (Q445, 446) is a low input impedance negative feedback amplifier which, with its input resistors R441 and R442, provides impedance matching with the characteristic impedance (Zo ≒ 186 ohms) of the delay line. With this low input impedance, the A & B trace separation circuit is connected in parallel.

o A & B trace separation circuit:

The A & B trace separation circuit vertically positions the trace by varying the currents which flow through resistors R444 and R445 from the input of the delay line receiver, as shown in Figure 6-4. In order to prevent intrusion of switching pulses, this circuit has a balanced current circuit (R446 and R447) and an unbalanced current circuit (Q441 and Q442), and these circuits are switched by the transistor switching circuit (Q443, 444). Balancing of the currents which flow in Q441 and Q442 is adjustable with the A & B TRACE SEPARATION potentiometer (RV601).

o Emitter follower:

The emitter follower (Q448, 449) converts the output signal of the delay line receiver into a low impedance to drive the final cascade amplifier. In order to suppress parasitic oscillations, the signal is fed from the emitters of Q448 and Q449 to the bases of Q450 and Q451 through R465 and R468.

o Final cascade amplifier:

The final cascade amplifier is a differential cascade amplifier comprising of a current amplification stage (Q450, 451) which has a high f_T in order to provide a sufficient output voltage to drive the vertical deflection plates of the CRT, and a voltage converter stage (Q454, 455) which employs high-voltage-type high-frequency transistors.

The right-angle compensation current signal of the X-Y alignment circuit is added to the output of the above current amplifier in order to maintain the perpendicularity of the axes on the CRT screen.

o X-Y alignment circuit:

The X-Y alignment circuit (Q452, 453) is a differential amplifier which provides a current signal to compensate for right-angle error of the axes on the CRT screen. This amplifier receives part of the horizontal deflection signal from the horizontal output amplifier and converts it into a perpendicularity compensation current signal, which is applied to the emitters of Q454 and Q455. The polarity and amount of the perpendicularity compensation current signal are adjustable with the X-Y ALIGN potentiometer (RV455).

6.6 A and B Trigger Generators

The A trigger generator is comprised of a trigger pulse generator circuit which produces a trigger pulse signal for driving the A (main) sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied. The B trigger generator produces a trigger pulse for driving the B (delayed) sweep generator when in the B TRIG'D mode.

A Trigger Generator:

As shown in Figure 6-5, the trigger pulse generator circuit of the A trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls

the start point (triggered point) of the signal waveform displayed on the CRT screen, a TV synchronization separator circuit which picks off the synchronization signal from the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

o Source switch:

The source switch (S501) selects the internal trigger signal fed from P-69, the line trigger signal fed from R1212, the the external trigger signal fed from J4, or the signal fed from F-4 and attenuated by a factor of 1/10 into the EXT ÷ TRIG signal. The selected signal is fed to the coupling switch.

o Coupling switch:

The coupling switch (S502) selects the coupling mode. Switch S502-2 selects the DC mode for direct coupling of the signal fed from S501, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S502-1 selects ON or OFF of the TV synchronization signal separator circuit which facilitates observation of a TV video signal.

o Impedance converter:

The impedance converter is a temperature-compensated-type cathode follower (Q501) with dual FETs. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal. The impedance is lowered further by the emitter follower of U501 and then the signal is fed to drive the level comparator circuit.

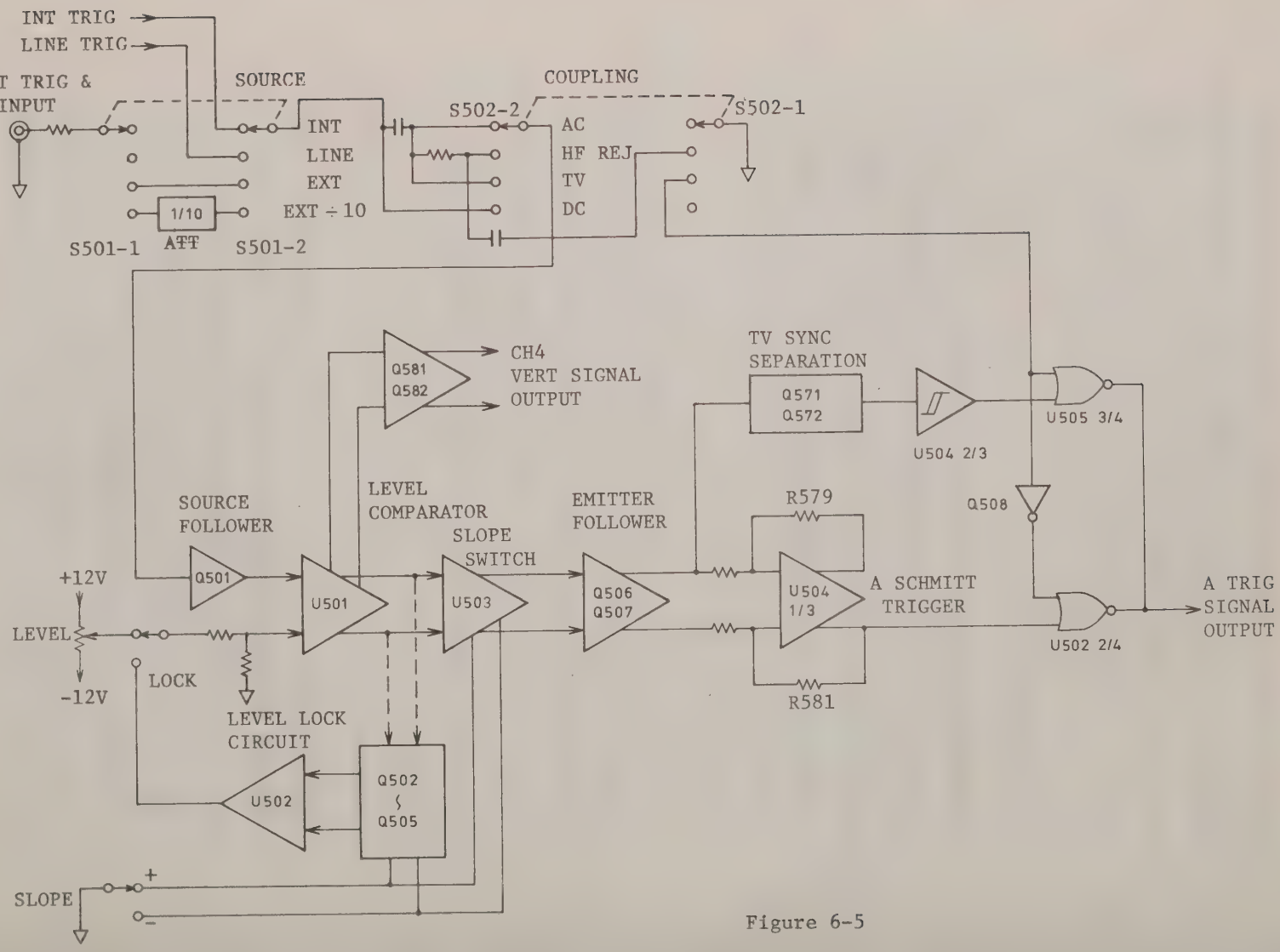

INT TRIG
LINE TRIG
A EXT TRIG &
CH4 INPUT
SOURCE
INT
LINE
EXT
EXT ÷ 10
1/10
ATT
S501-1
S501-2
COUPLING
S502-2
S502-1
AC
HF REJ
TV
DC
Q581
Q582
CH4
VERT SIGNAL
OUTPUT
TV SYNC
SEPARATION
Q571
Q572
U504 2/3
U505 3/4
Q508
R579
SOURCE
FOLLOWER
LEVEL
COMPARATOR
SLOPE
SWITCH
EMITTER
FOLLOWER
+12V
LEVEL
-12V
Q501
U501
U503
Q506
Q507
U504
1/3
A SCHMITT
TRIGGER
A TRIG
SIGNAL
OUTPUT
U502 2/4
LOCK
R581
LEVEL LOCK
CIRCUIT
U502
Q502
Q505
SLOPE
+
-

Figure 6-5

o Level comparator:

The level comparator is a differential cascade amplifier (U501, U503) which adjusts the rise up portion (or the fall down portion) of the comparator output signal by applying to U501 No. 9 of the current amplifier stage the trigger source signal from the impedance converter circuit and adding to U501 No. 8 the comparator level signal from the LEVEL control potentiometer (R501). In this case, if switch S503 which is linked to the LEVEL control potentiometer is locked, the comarator level signal is applied to U501 No. 8 from the level lock circuit and the trigger point is fixed at the center amplitude of the trigger source signal. The level lock circuit amplifies with its error amplifier the error signal detected by Q502 - Q505 and feeds back the signal so that the center level of the comparator output signal becomes the Schmitt level of the Schmitt trigger circuit.

The SLOPE switch (S505) selects a slope by switching the voltage converter stage of the cascade amplifier by changing polarity of U503.

The output signal of the cascade amplifier is fed via the impedance converter (Q506, 507) to the TV synchronization signal separator circuit and the regular (non-TV) Schmitt circuits.

o TV synchronization signal separator circuit:

The TV synchronization signal separator circuit (Q571) is a base leak type circuit and picks off the synchronization signal from a video signal. When in the TV.H synchronization mode, the output signal is directly fed to the TV SYNC Schmitt trigger circuit U504 2/3. When in the TV.V synchronization mode, the circuit produces a TV.V synchronization signal by grounding with transistor Q502 the capacitors (C502, 507) which is connected so that the input resistance of the Schmitt

trigger circuit becomes the integration resistance of the integration circuit. Switching between TV.V and TV.H is done being linked to the TIME/DIV switch within the following ranges:

TV.V: 0.5 sec - 0.1 msec ranges
TV.H: 50 usec - 0.1 µsec ranges

o A TRIG Schmitt circuit:

The A TRIG Schmitt circuit is a differential type circuit which generates a hysteresis voltage by applying a feedback signal with R579/581 to the ECL line receiver of U504 1/3. The output of the Schmitt circuit drives the A SWEEP generator and AUTO circuit via the NORM/TV switching circuit.

o AUTO circuit:

The AUTO circuit converts with its pulse converter (U505 2/4, 4/4, Q573) the high-speed pulse signal of the trigger pulse generator into a low-speed pulse signal which is applied to the CH1, CH2 and CH3 stable multivibrators (702 1/2, 2/2, U701 2/2) to generate the CH1, CH2 and CH3 AUTO signals. With the AUTO switching pulse signal received from the vertical switching circuit, the CH1, CH2 and CH3 signals are switched by the AUTO signal switching circuit (U703). The switched AUTO signal is conditioned for waveform-shaping by the Schmitt circuit (U504 3/3) to drive the A sweep generator and the TRIG'D LED lamp.

B Trigger Generator

The B trigger generator is identical with the A trigger generator except that the former has no AUTO circuit since no such circuit is required for its operation.

6.7 A and B Sweep Generators

The A sweep generator produces the sawtooth signal for the main sweep (A sweep) of this oscilloscope. The B sweep generator produces the sawtooth signal for magnification in the time axis direction the waveform displayed on the main sweep or for display with a certain time delay (delayed sweep or B sweep).

The A sweep generator consists of the A sweep gate circuit which receives the trigger signal from the A trigger generator and produces the sweep gate signal for starting sweeps, the sweep start comparator which maintains stably the sweep start point, the A sawtooth sweep generator which produces a sawtooth wave in conformity with the time constant selected by the TIME/DIV switch, the sweep length circuit which controls the length of sweeps, the hold off circuit which controls the sweep return period and pause period, and the A sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

o A sweep gate:

The A sweep gate circuit employs a flip-flop ECL IC with reset/clear function. The trigger pulse of the A trigger generator is applied to the CLOCK (No. 11) terminal, the enable signal of the A sweep gate enable circuit to the SET (No. 12) terminal, and the enable signal and AUTO signal of the AUTO circuit to the RESET (No. 13) terminal through the NOR gate circuit. The Q (No. 14) terminal output is applied as the unblanking signal to the Z-axis amplifier and the $\overline{Q}$ (No. 15) terminal output is fed to the sweep start comparator circuit and becomes the A sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AUTO signal of the RESET terminal so that the A sweep gate signal is generated and the circuit operates in the free-run mode.

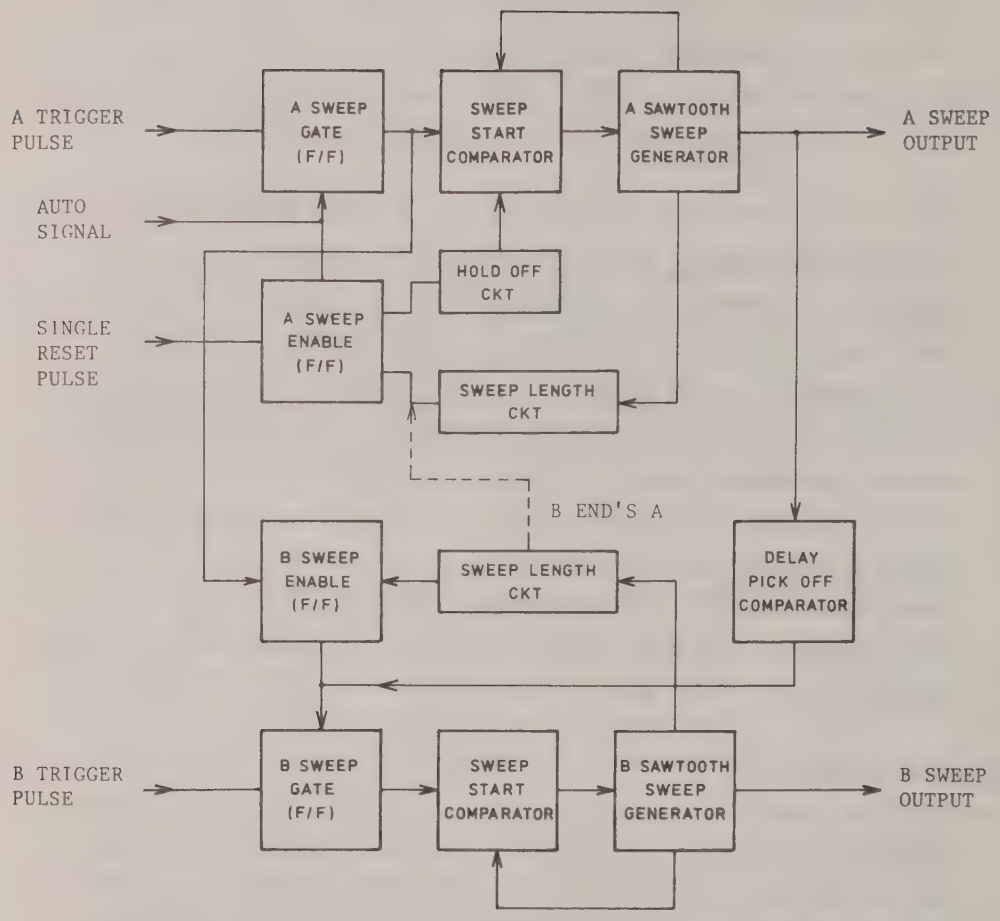

A TRIGGER PULSE
A SWEEP GATE (F/F)
SWEEP START COMPARATOR
A SAWTOOTH SWEEP GENERATOR
A SWEEP OUTPUT
AUTO SIGNAL
HOLD OFF CKT
SINGLE RESET PULSE
A SWEEP ENABLE (F/F)
SWEEP LENGTH CKT
B END'S A
B SWEEP ENABLE (F/F)
SWEEP LENGTH CKT
DELAY PICK OFF COMPARATOR
B TRIGGER PULSE
B SWEEP GATE (F/F)
SWEEP START COMPARATOR
B SAWTOOTH SWEEP GENERATOR
B SWEEP OUTPUT

Figure 6-6

o Sweep start comparator:

The sweep start comparator (Q802, 803) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. A start reference level identical with the B sweep start level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

o A sawtooth generator:

The A sawtooth generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit, and a logic circuit which controls the switching circuit. The gate transistor amplifier (Q810) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q809, Q811, 812) produces a sawtooth signal with the time constant selected by the integration time constant selector circuit. The integration time constant selector circuit selects integration capacitor C811/C812 with U802 1/4, 2/4. For integration current, R833 - 836 are selected by Q818 - 821 and R828 - 830 by CR811 - 813. The logic circuit selects an integration capacitor and a resistor in conformity with the range selected by the TIME/DIV switch (S801) in order to control the integration time constant selector circuit.

o Sweep length circuit:

The sweep length circuit divides with its voltage divider (R731, RV701, R732) the output of the A sweep generator, shapes the waveform with its Schmitt circuit (U706 2/3), and produces the length signal. The B END A signal is added to the signal of No. 5 pin of U704.

o Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with the Miller integrator (Q807) and making use of the fall time of the triangular wave. The integrator, with its Q805 and Q806, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the Miller integrator is detected by Q804 and shaped by the Schmitt circuit (U706 3/3) into a holdoff signal. The trigger pulse is fed to the reference input of the Schmitt circuit via C708 in order to suppress jitter which could be produced when in high speed sweep.

o A sweep gate enable circuit:

The A sweep gate enable circuit employs the flip-flop IC (U704 1/2) which makes up a pair with the A sweep gate circuit. The holdoff signal is applied to the RESET (No. 4) terminal, the length signal is applied to the SET (No. 5) terminal, and the enable signal is delivered from the Q (No. 2) terminal. This enable signal resets or sets the A sweep gate circuit. When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle and a one-shot sweep is effected by the reset signal applied from the CLOCK (No. 6) terminal.

The basic structure of the B sweep generator is identical with that of the A sweep generator. It consists of the B sweep gate, sweep start comparator, B sawtooth generator, sweep length circuit, B sweep enable circuit, and delay pickoff comparator. The B sweep generator requires no holdoff circuit because it operates only during the period the A sweep generator is in the sweep operation. Instead of the holdoff signal, the A sweep gate signal sets the B sweep enable circuit to the enable state.

o Delay pickoff comparator:

The delay pickoff comparator (Q704 - 707) employs a dual FET (Q706) to obtain a certain time relationship as set by the delay time multiplication potentiometer (RV705) with respect to the A sweep signal. The comparator compares the A sweep output signal (sawtooth waveform) with the voltage set by RV705, generates a delayed sweep start signal, and sets the B sweep gate circuit to start the B sweep signal. When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start signal but the RESET (No. 13) terminal is set in the low state and the B sweep signal is started as driven by the trigger pulse of the B trigger generator.

6.8 Horizontal Switching Circuit

The horizontal switching circuit is comprised of a switching buffer circuit which prevents switching distortion from being sent to the sweep circuit of the preceding stage, a display switching circuit which electronically switches the A and B sweep signals, a 10 × MAG circuit which magnifies the sweep signal by 10 times, and a horizontal mode switching circuit which selects either CH1 or CH3 signal for the horizontal axis.

o Switching buffer circuit:

The switching buffer circuit is of a grounded-base-type amplifier. Transistor Q1001 is for buffer-amplification of the A sweep signal, transistor Q1002 for the B sweep signal.

o Display switching circuit:

The display switch circuit has a diode switching circuit (CR1002, 1003) which turns on and off the A and B sweep signals by controlling the emitter currents of transistors Q1003 and Q1004. The on-off actions of diodes CR1002 and CR1003 are controlled by U1002 1/2 IC as dictated by the DISPLAY switch (S1001). U1002 2/2 IC generates

the vertical ALT switching pulse signal. The switched sweep signal is fed to the ×10 MAG circuit, which is used also to drive the horizontal mode switching circuit.

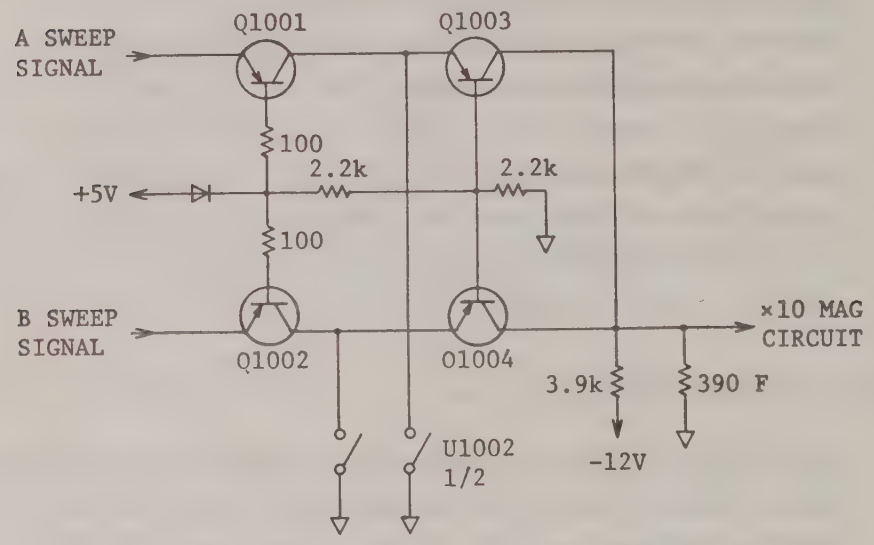


Figure 6-7

o ×10 MAG circuit:

The ×10 MAG circuit converts the sweep signal selected by the display switching circuit into a balanced signal with its transistors Q1008 and Q1009, and it also synthesizes the ↔ POSITION signal.

The ×10 MAG circuit magnifies the gain by 10 times by selecting the emitter coupling resistors of Q1008 and Q1009 with switching transistors Q1006 and Q1007.

o Horizontal mode switching circuit:

The horizontal mode switching circuit (Q1010 - 1013) is a solid-state switching circuit made up of transistors with their collectors connected together. Transistors Q1010 and Q1011 switches

the sweep signal received from the ×10 MAG circuit; transistors Q1012 and Q1013 switches the CH3 HORIZONTAL signal received from P-57.

6.9 Horizontal Output Amplifier

The horizontal output amplifier consists of a drive amplifier which converts and conditions the above signal into a balanced signal and drives the output amplifier, and an output amplifier which drives the horizontal deflection plates of the CRT.

- o Drive amplifier:

The drive amplifier (Q1051 - 1054) limits the amplitude of the horizontal signal received from the horizontal switching circuit and drives the output amplifier via the diode limiter. Also, it delivers the signal as an X-Y alignment signal of the collector of Q1052 to the vertical output amplifier.

- o Output amplifier:

The output amplifier (Q1057 - 1064) is comprised of feedback-type SEPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal current-amplified by Q1057/1059 and Q1058/1060 is converted into a voltage signal by Q1061/1063 and Q1062/1064 to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R1077/R1080 a stable gain and wide and flat frequency response are attained.

6.10 Z-axis Amplifier

The Z-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signals of the A and B sweep generators, the external intensity modulation signal applied through the Z-axis input terminal, the

B intensity control signal, and the overall intensity control signal. The output amplifier amplifies the merged signal into a sufficient level for driving the G1 grid of CRT.

- o Input circuit:

The input circuit produces the main unblanking signal by merging through the gate circuit (U708 3/4 4/4) the unblanking signals of the A and B sweep generators and the A intensity gate signal of the horizontal switching circuit. The input circuit also adds to the above merged signal, as selected by the display switch (S1001) and the vertical mode switch (S351), the B intensity control signal, the chopped blanking signal, the external intensity modulation signal applied via the X-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

- o Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is of a feedback-type SEPP circuit (Q1149 - 1156) similar to that of the horizontal output amplifier. This amplifier also generates a linear focus signal which is in the inverted phase of the unblanking signal. The amplified unblanking output signal and linear focus signal are fed to the G1 and P1 of the cathode-ray tube through the CRT circuit to drive the intensity and focus of the displayed waveform.

6.11 CRT Control Circuit

The CRT control circuit is comprised of a DC regeneration circuit which converts the linear focus signal and the unblanking output signal of the Z-axis amplifier into the operating-voltage signals of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers HALATION (RV1104), ASTIG (RV1103), GEOMETRY (RV1105) and SUB-FOCUS (RV1102), a trace rotation circuit for adjusting the trace direction in parallel

with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

- o DC regeneration circuit:

  The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respects to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

6.12 HV Regulator (High Voltage Generator)

The high voltage generator produces an acceleration voltage (-1850 V) applied to the CRT cathode and a post-acceleration voltage (approximately +18 kV) applied to the CRT anode to accelerate the electrons beam which have passed the X and Y deflection plates and mesh electrode. The high voltage of approximately 3700 Vp-p (frequency approximately 30 kHz) generated by the blocking oscillator is 10-times voltage-multiplication rectified by a Cockcroft circuit into a positive voltage of approximately 18 kV and it is half-wave rectified into a negative voltage of -1850 V.

This DC-DC converter feeds the negative voltage of -1850 V via a high resistance circuit (R1114, R1115) to the control circuit (Q1101 - 1103) to obtain a stabilized acceleration voltage. It also is fed through a capacitor-coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

6.13 Power Supply Circuit

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required by means of the line voltage selector plug (P-89). Regarding the secondary circuit, the transformer has one 6.3 V winding for the CRT heater and four windings of different voltages for different circuits of the CRT. The AC voltages of these four windings are rectifies and supplied as regulated +21 V power and non-regulated +160 V, +56 V, +12 V, +5 V, and -12 V powers.

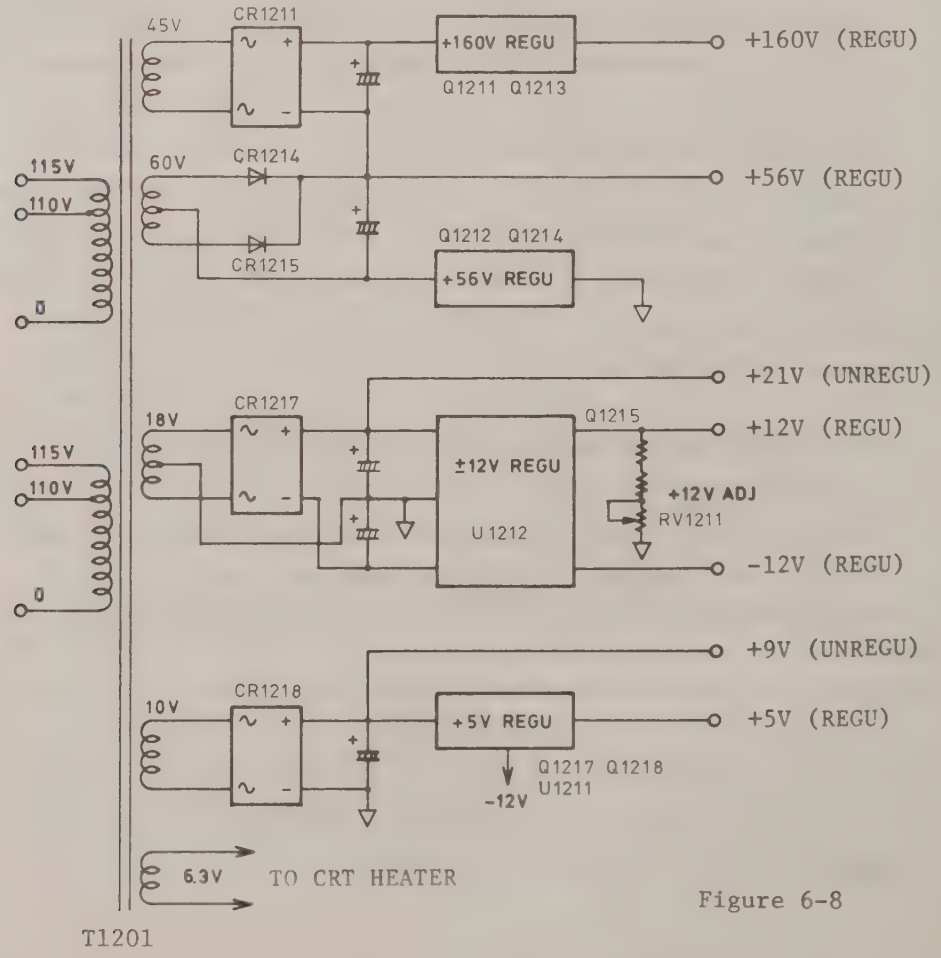


Figure 6-8

6.14 Calibrator Circuit

The calibrator circuit provides square-wave calibration voltage signals of 2 Vp-p and 200 mVp-p which are used for calibration of the probe and the amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signals are produced by generating a signal with the multibrator of CMOS IC (U1101 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1101 3/4, 4/4), and dividing the voltage signal with resistors.

7. CALIBRATION

7.1 General

After the oscilloscope has been used for a period of time, it should be calibrated. Although calibration of overall performances is recommended, partial calibration may serve the purpose as that the time axis alone is calibrated when the time measuring accuracy is especially important or that the vertical axis alone is calibrated when the vertical sensitivity accuracy is of prime importance. After the oscilloscope has been repaired, overall calibration is suggested although it depends on the type of repair. For accurate calibration service, contact your Kikusui agent.

7.2 Removing the Case

To remove the case, remove the six screws (Figure 7-1) and pull out the chassis forward.

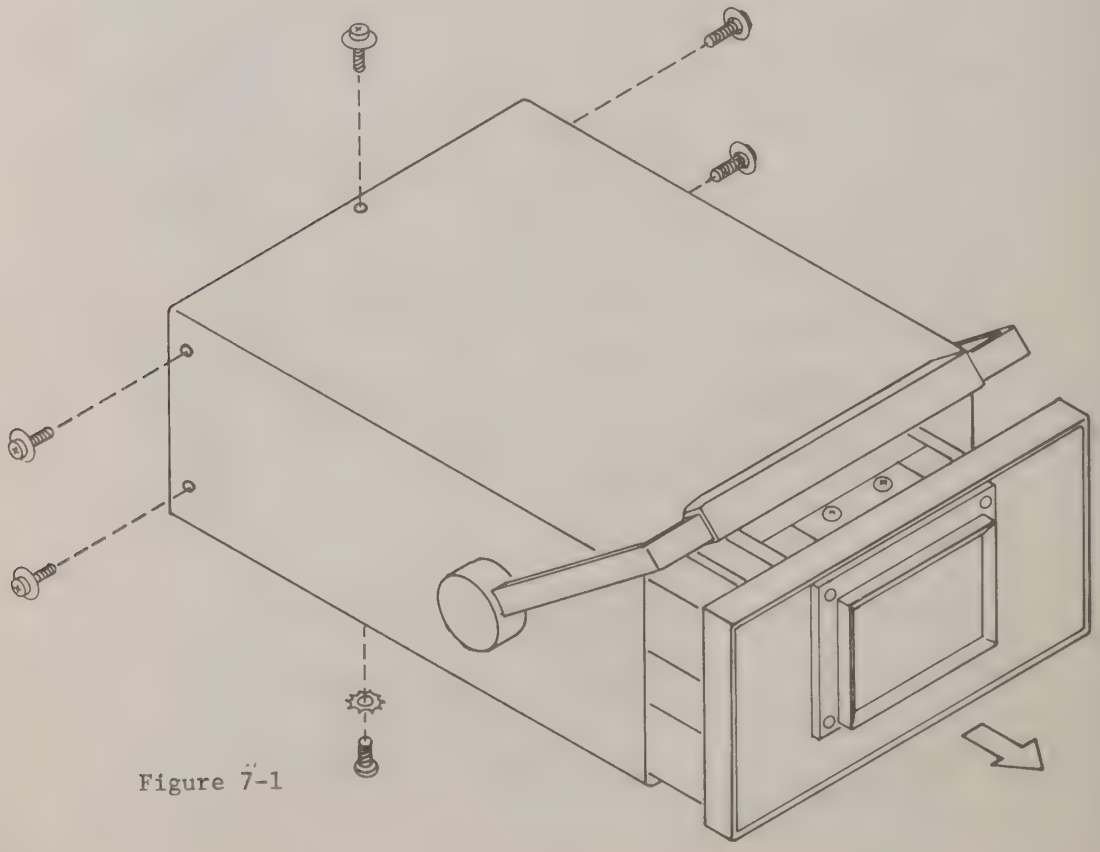


Figure 7-1

7.3 Check and Adjustment of DC Supply Voltages

Before calibrating the oscilloscope, its DC supply voltages should be checked and adjusted. Check and adjust the +12V supply voltage first and the other supply voltages next. The supply voltages shown in the following table and the check and adjustment points are indicated in Figures 7-2, 7-8 and 7-9.

Nominal voltage	Voltage range	Check ~~and adjustment~~ points
+ 5 V	+4.75 - 5.25 V	TP-2
+12 V	+11.95 - 12.05 V	TP-3 RV1211
-12 V	-11.80 - 12.20 V	TP-1
+56 V	+54 - 60 V	TP-4
+160 V	+155 - 165 V	TP-5
-1850 V	-1840 - -1860 V	TP-6 RV1101

For voltage check, measure the voltage between check point and ground using precision digital voltmeter. The +12V supply must be especially carefully adjusted because it provides a reference for other supplies. To mreasure the -1850V supply of which internal impedance is high, use a voltmeter which has a sufficiently high input impedance (10 MΩ or over).

Because adjustments of supply voltages largely affects vertical sensitivity and horizontal sweep time, the oscilloscope must be re-calibrated as explained in the subsequent paragraphs.

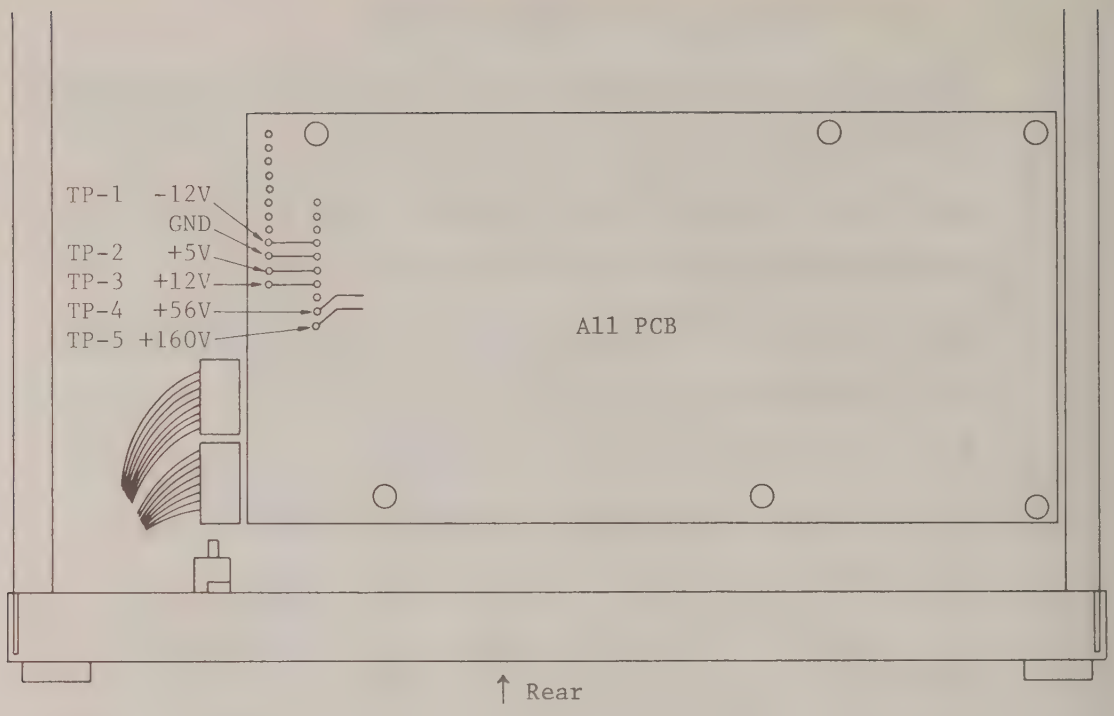


Figure 7-2 (Bottom view)

7.4 Adjustment of CRT Circuits

Some adjustments of the CRT circuits directly affect the CRT deflection sensitivity as is the case of "Check and Adjustment of DC Supply Voltages" of the preceding section. After the GEOMETRY, HALATION and HORIZ LIMIT are adjusted, the vertical sensitivity and sweep time must be calibrated.

- Adjustment of SUB INTEN:

  This control is for adjusting the trace intensity and the operating position of the INTEN knob (7).

(1) Set the TIME/DIV switch (39) at 1 mS and display a single-line horizontal trace on the screen.

(2) Set the white mark of the INTEN knob at the 10 o'clock position and so adjust the SUB INTEN control (Figure 7-9, RV1141) that the trace is displayed on the screen with a barely discernible intensity.

o Adjustment of GEOMETRY:

This control is for reducing geometrical distortions (pincushion distortions or barrel distortions) of the pattern displayed on the screen.

(1) Apply a sinusoidal signal of approximately 50 kHz to vertical input terminal and display the signal with an amplitude of 8 DIV and with approximately 50 peaks.

(2) So adjust the GEOMETRY control (Figure 7-9, RV1105) that the displayed pattern becomes as (b) in Figure 7-3.

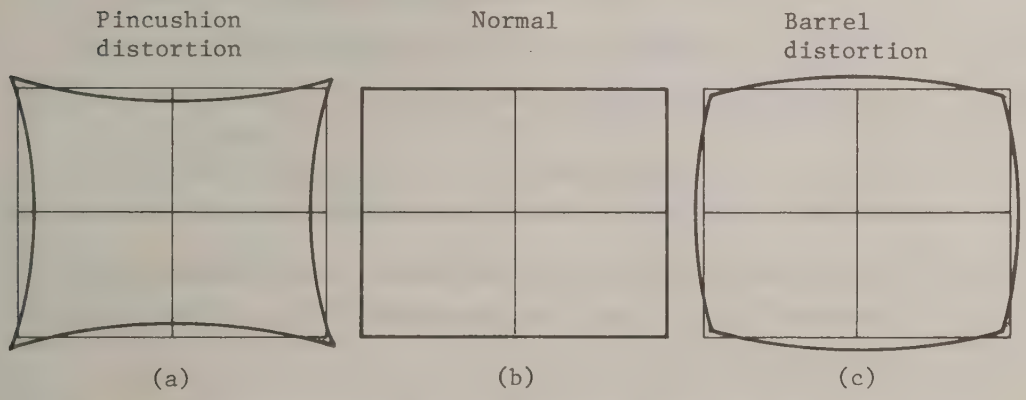


Figure 7-3

o Adjustment of HALATION:

This control is used to reduce halation on the screen to improve the contrast of the displayed waveform.
So adjust the HALATION control (Figure 7-9, RV1104) that the best focus is obtained with the ASTIG voltage set at +70 to +80 volts.

o Adjustment of SUB-FOCUS:

This control is for adjusting the control range position of the FOCUS knob (5). With the FOCUS knob set with its white dot positioned upright (noon position), so adjust the SUB-FOCUS control (Figure 7-9, RV1102) that the best focus is obtained.

o Adjustment of HORIZ LIMIT:

This control is used to suppress halation (caused by the electron beam reflected and scattered in the cathode-ray tube) resulting from change in the horizontal POSITION adjustment and × 10 MAG operation.

(1) Apply the CAL (43) signal to the vertical input terminals and display a waveforms with amplitude 4 DIV and 10 peaks.

(2) Pull out the 10 × MAG switch (41). Turn the HORIZ LIMIT control (Figure 7-8, RV1051) from the extremely counter-clockwise position gradually to clockwise position and stop at the position where halation on the screen is reduced. This is the normal position for the HORIZ LIMIT control.

o Adjustment of Y AXIS ALIGN:

This control is for adjustment of the perpendicularity (90°) between horizontal trace (sweep) and vertical trace.

(1) Ground CH1. Apply to CH2 the output of a sine wave signal generator and display the signal with an amplitude of 8 DIV on the screen.

(2) Set the VERT MODE switch (26) in the X-Y mode and so adjust the TRACE ROTATION control (4) that the vertical trace becomes parallel with the graticule scale.

(3) Next, change the VERT MODE switch to CH1 and so adjust the X-Y AXIS ALIGN (Figure 7-8, RV445) that the horizontal trace becomes parallel with the horizontal scale of the graticule.

By the above procedure, the horizontal trace and vertical trace are adjusted mutually perpendicular.

7.5 Adjustment of Vertical Axis

o Adjustment of STEP BAL:

This control is for minimizing the shift of trace when the VOLTS/DIV switch (16) or (23) is turned from the 5 mV position to the 10 mV position.

(1) Set the AC-GND-DC switch (13) or (20) in GND stage and display the trace on the CRT screen.

(2) Turning the VOLTS/DIV switch between 5 mV and 10 mV positions, so adjust the STEP BAL control (Figure 7-11, RV101 or RV201) that the shift of trace becomes minimum.

o Adjustment of DC BAL:

This control is for minimizing the shift of the trace when the VARIABLE KNOB (15) or (22) is turned.

(1) Set the AC-GND-DC switch (13) or (20) in the GND stage and display the trace on the CRT screen.

(2) Turning the VARIABLE knob, so adjust the DC BAL control that the shift of the trace becomes minimum. (Figure 7-11, RV102 and RV202)

o Adjustment of × 5 MAG BAL:

This control is for minimizing the shift of trace when the × 5 MAG switch (15) or (22) is changed.

(1) Set the AC-GND-DC switch (13) or (20) in the GND state and display a trace on the screen.

(2) Turning on and off the × 5 MAG switch, so adjust the × 5 BAL (Figure 7-11, RV104 or RV204) that the shift of trace becomes minimum.

o Sensitivity calibration of CH1 and CH2:

Calibrate the sensitivity of the vertical amplifier to the value indicated by the VOLTS/DIV switch (16) or (23). For this adjustment, use a square wave generator with an output voltage setting accuracy of 0.3% or better, at 1 kHz.

(1) Set the signal generator output at 80 mVp-p and apply the signal to the vertical input terminal (14) or (21).

(2) Set the VARIABLE knob (15) or (22) at the CAL'D position and set the VOLTS/DIV switch at the 10 mV range.

(3) So adjust the CH1 or CH2 GAIN control (Figure 7-11, RV109 or RV209) that the amplitude of the displayed waveform becomes 8 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±2% or better.

o Sensitivity calibration of CH3:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivity of the CH3 vertical amplifier.

(1) Set the signal generator output at 800 mVp-p and apply the signal to CH3 input terminal (12). Next, set the CH3 input ATT switch (9) to the 0.1 V state (⊓ state).

(2) So adjust the CH3 GAIN control (Figure 7-10, RV303) that the amplitude of the displayed waveform becomes 8 DIV.

o Sensitivity calibration of CH4 and CH5:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivities of CH4 and CH5 vertical amplifiers.

(1) Set the signal generator output at 400 mVp-p and apply the signal to CH4 input terminal (36) or CH5 input terminal (46).

(2) Change the source selector switch (35) or (48) to the EXT state and display a signal waveform on the screen. So adjust the CH4 or CH5 GAIN control (RV503 or RV661 in Figure 7-12 or Figure 7-10) that the signal is displayed with an amplitude of 4 DIV on the screen.

Adjustment of VERT CENTER:

This adjustment is to make zero the shift of trace at the center of the screen when the CH2 INV switch is changed.

(1) Set the AC-GND-DC switch (13) in the GND state and display the trace on the screen.

(2) Turning ON (⊓) and OFF (⊔) the CH2 INV switch (26) , so adjust the POSITION knob (17) that the shift of trace becomes zero.

(3) Under the above state, so adjusted the VERT CENTER control (Figure 7-11, RV446) that the trace is positioned at the center of the screen.

Adjustment of ADD BAL:

With both CH1 and CH2 channels operating in a single-line horizontal trace mode at the center of the screen, so adjust this control that the traces do not shift even when the VERT MODE switch is changed to the ADD mode.

(1) Set the AC-GND-DC switches (13) and (20) in the GND state and display the traces of the two channels overlapped at the center of the screen.

(2) Change the VERT MODE switch to the ADD state and so adjust the ADD BAL control (Figure 7-11, RV401) that the traces are positioned at the center of the screen.

o Adjustment of square wave characteristics of vertical amplifiers:

This adjustment is to adjust the square wave characteristics of the vertical amplifiers and to make their frequency response flat. This adjustment should be done at a range which does not use the input attenuator (5 mV/DIV range), using two or more square waves of different frequencies.

Adjustment should be done using a quality square wave with a rise time of 1.0 nsec or faster, in the order of low, middle, and high ranges, repeating adjustment for a few times.

(1) Adjustment for low frequency range:

Set the VOLTS/DIV switch at 10 mV/DIV and the TIME/DIV switch at 20 μS/DIV. Apply to the vertical input terminal a square wave of 10 kHz and so adjust the signal generator output that the waveform is displayed with an amplitude of 6 DIV.

Next, so adjust RV444 (Figure 7-8) that the displayed waveform becomes as (b) in Figure 7-4.

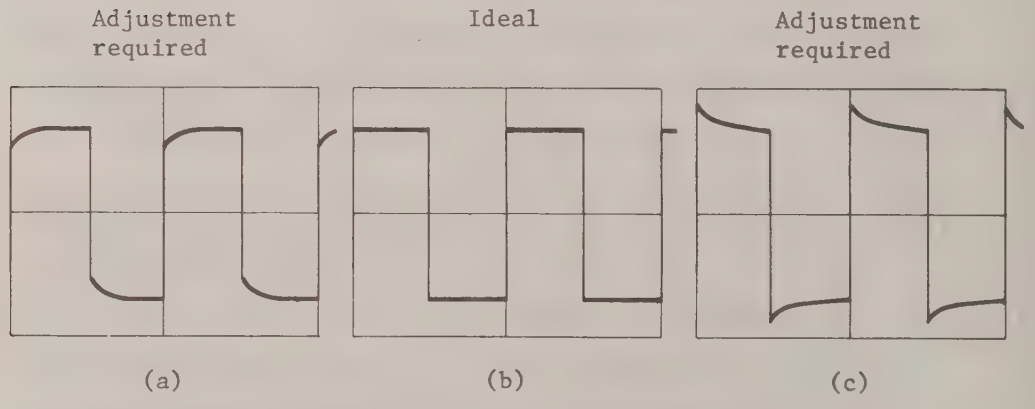


Figure 7-4

(2) Adjustment for middle frequency range:

Change the input pulse signal frequency to 1 MHz and set the TIME/DIV switch at 0.2 μS/DIV. Next, so adjust RV443 (Figure 7-8) that a square wave as shown in (b) of Figure 7-5 is displayed. Also, so adjust RV442 and C446 that the square wave characteristics at the front edge of the waveform becomes flat. For this adjustment, set at first R442 at an appropriate position and then adjust C446 so that a waveform as close to that of (d) as possible is obtained. Repeat this procedure for a few times so that a waveform as shown in (d) is obtained.

(3) Adjustment for high frequency range:

This adjustment is to make still more sharp the leading edge and reduce ringing at the leading edge of the pulse waveform which has been adjusted in step (2).

For this adjustment, adjust at first CH1 and CH2 to the same characteristics and adjust CH3, CH4 and CH5 next.

Change the TIME/DIV switch to the 20 mV/DIV position and expand the front edge of the pulse waveform which has been adjusted in step (2) "Adjustment for middle frequency range." First, adjust RV441 and C446 so that ringing becomes smaller and uniform. Next, adjust C445 so that ringing is eliminated.

Next, adjust RV402 and C410, and RV106 and C141 (RV206 and C241 in the case of CH2) so that the front edge of the displayed waveform becomes flat. Also adjust C407 and C142 (C242 in the case of CH2) so that the leading edge becomes sharp.

Repeat the above adjustment so that flat square wave characteristics with sharp leading edge is obtained and the difference between CH1 and CH2 becomes minimal.

Next, change the channels to CH3, CH4 and CH5, and adjust the HF COMPEN controls of these channels.

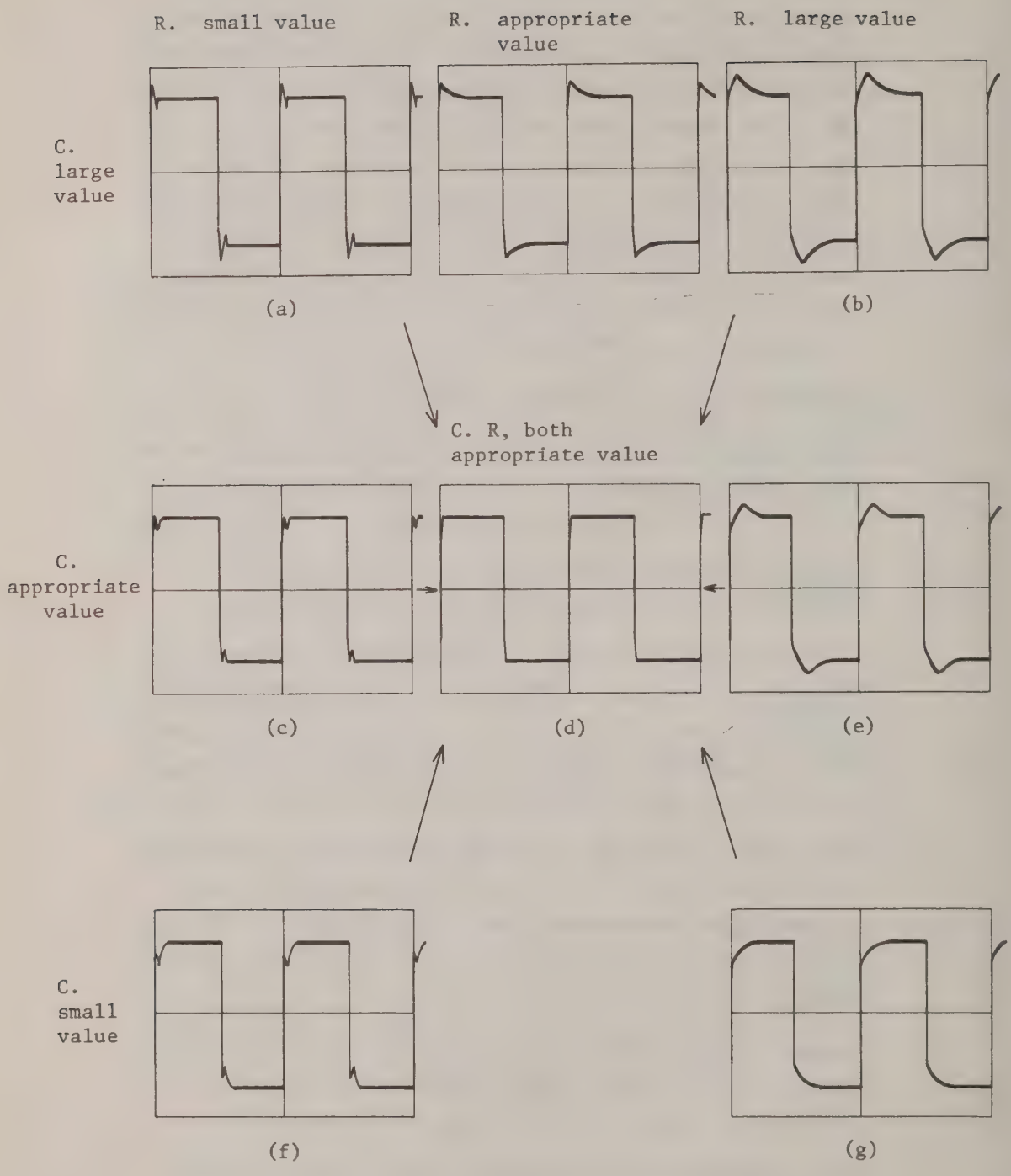

R. small value
R. appropriate value
R. large value
C. large value
(a)
(b)
C. R, both appropriate value
C. appropriate value
(c)
(d)
(e)
C. small value
(f)
(g)

Figure 7-5

	HF COMPEN
CH3	RV302 C316
CH4	C582
CH5	C662

After the above adjustment is done, check again that the frequency response characteristics of all channels are satisfactory.

ó Adjustment of input ATT of CH1 and CH2:

The VOLTS/DIV switch selects the oscilloscope sensitivity by switching the attenuator circuit consisting of pre-stage attenuator (1/10-steps) and post-stage attenuator (1/1, 1/2, and 1/5-steps). This procedure is for phase compensation and input capacitance adjustment of the attenuators. Adjustments should be done in the order of phase compensation and input capacitance adjustment for the post-stage attenuator and then phase compensation and input capacitance adjustment of the pre-stage attenuator.

(1) Adjustment of post-stage attenuator:

Use a square wave signal generator which provides a quality square wave of rise time 1 µsec or faster, without sags or overshoots. Apply the signal for each of the ranges (20 mV, 50 mV) and display a waveform with an amplitude of 6 DIV. So adjust the phase compensation capacitors shown in the following table that an ideal waveform is displayed. Next, connect a low-capacitance C-meter to the input terminal and so adjust the input-capacitance compensation capacitor that the input capacitance at each range becomes 20 pF ±2 pF.

Compensation capacitor / Range	CH1		CH2	
	Phase compensation	Input capacitor	Phase compensation	Input capacitor
20 mV (1/2)	C112	C113	C212	C213
50 mV (1/5)	C114	C115	C214	C215

(2) Adjustment of pre-stage attenuator:

In a similar manner as in the case of step (1), adjust at each of 0.1 V and 1 V ranges the phase compensation capacitors and input capacitance compensation capacitors as shown in the following table.

Compensation capacitor / Range	CH1		CH2	
	Phase compensation	Input capacitor	Phase compensation	Input capacitor
0.1 V (1/10)	C104	C105	C204	C205
1 V (1/100)	C107	C108	C207	C208

When the above adjustment is done, all other ranges also are automatically adjusted.

o Adjustment of input ATT of CH3:

In a similar manner as is the case for "Adjustment of input ATT of CH1 and CH2," adjust C305 so that the 1/1 input capacitance becomes 20 pF ±2 pF. Next, adjust input capacitance compensation capacitor C303 and phase compensation capacitor C302 of 1/10 ATT. (See Figure 7-10.)

Adjustment of input ATT of CH4 and CH5:

In a similar manner as above, adjust input capacitance compensation capacitors C502 (CH4) and C612 (CH5) and phase compensation capacitors C503 (CH4) and C611 (CH5) of 1/10 ATT. (See Figure 7-12 and 7-10.)

o Adjustment of DC offset CH1 signal output:

This adjustment is to make zero the DC offset of the CH1 signal output.

(1) Apply the CH1 signal output to the CH2 input terminal.

(2) Display the CH2 input signal on the screen and set the VOLTS/DIV switch at the 10 mV range.

(3) Changing the CH2 input coupling switch between GND and DC, so adjust the CH1 SIGNAL OUTPUT DC OFFSET control RV110 (Figure 7-11) that shift of the trace becomes zero.

7.6 Adjustment of Trigger Circuit

o Adjustment of CH1 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH1 internal trigger output.

(1) Apply a sinusoidal signal of approximately 1 kHz to the CH1 input terminal and set the AC-GND-DC switch at AC.

(2) Set the VERT MODE switch at CH1, set the INT TRIG switch at CH1 or ALT, and display the signal with an amplitude of 8 DIV on the screen.

(3) Set the COUPLING switch at AC and so adjust the LEVEL knob that the trigger point is brought to the center of the displayed waveform amplitude.

(4) Change the COUPLING switch to DC and so adjust the CH1 TRIG DC OFFSET (Figure 7-11, RV107) that the trigger point is brought to the center of the displayed waveform amplitude.

o Adjustment of CH2 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH2 internal trigger output.

For this adjustment, adjust CH2 TRIG DC OFFSET (Figure 7-11, RV207) in a similar manner as is the case for "Adjustment of CH1 TRIG DC OFFSET."

o Adjustment of CH3 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH3 internal trigger output.

For this adjustment, adjust CH3 TRIG DC OFFSET (Figure 7-10, RV304) in a similar manner as is the case for "Adjustment of CH1 TRIG DC OFFSET."

7.7 Adjustment of Time Base

o Calibration of A sweep time:

This adjustment is for calibrating the sweep time to the values indicated by the TIME/DIV switch (39). For this adjustment, use time marker signals of accurate time intervals of 0.1 sec, 1 msec and 10 µsec or use signals of accurate frequencies of 10 Hz, 1 kHz and 100 kHz.

(1) Apply to the vertical input terminal a time marker signal of 0.1 sec or a signal of 10 Hz, and deflect the signal with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (41) in the CAL'D position. Set the TIME/DIV switch (39) at 0.1 sec.

(3) So adjust the 0.1S ADJ (Figure 7-9, RV802) that the displayed waveform conforms with scale divisions of the graticule.

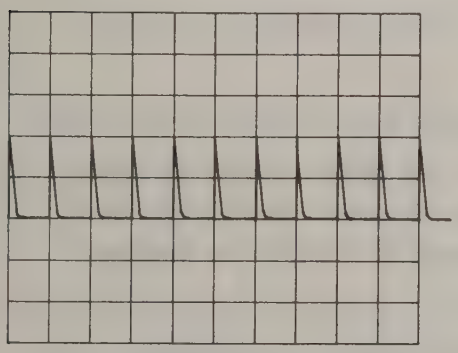
(4) Change the input signal to a time marker signal of 1 msec or sinusoidal wave signal of 1 kHz and change the TIME/DIV switch (39) to 1 msec.

(5) So adjust the 1mS CAL (Figure 7-9, RV801) that the displayed signal waveform conforms with scale divisions of the graticule.

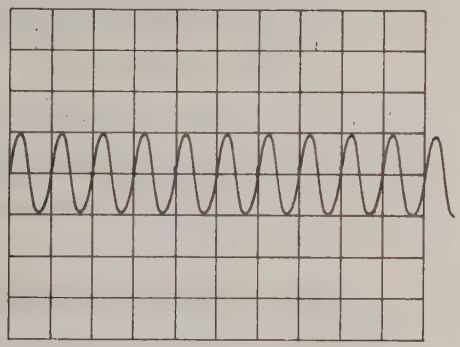
(6) Next, change the input signal to a 10-µsec time marker signal or a 100-kHz repetitive frequency signal and change the TIME/DIV switch indication to 10µS.

(7) So adjust C814 (Figure 7-9) that the displayed signal waveform conform with scale divisions of the graticule.

When the above calibration is complete, the sweep speeds of the remaining ranges of the TIME/DIV switch (39) also are calibrated at an accuracy of ±3%.



Time marker signal



Sinusoidal wave signal

Figure 7-6

o Calibration of B sweep time:

Calibrate the sweep time to the indicated values of the TIME/DIV switch (40). Adjust 0.1S and 1mS (Figure 7-9, RV902 and 901) and C904 (Figure 7-9) in a similar manner as that for the case of "Calibration of A sweep time."

o Adjustment of SWEEP LENGTH:

This adjustment is for setting the lengths of the A and B sweeps at 11 DIV. Set the TIME/DIV switches (39) and (40) at 1 mS and apply a time marker signal of 1 msec or a signal of repetition frequency 1 kHz, and so adjust the A SWEEP LENGTH (Figure 7-9, RV701) and B SWEEP LENGTH (Figure 7-9, RV702) that the sweep length become 11 DIV.

o Adjustment of sweep start point:

This adjustment is for attaining such state that, when the horizontal POSITION knobs (44) and (45) are set with their white dots in the noon positions, their sweeps start at the left hand end of the graticule.

(1) Set the TIME/DIV switches (39) and (40) at 1 mS, set the DISPLAY switch (29) at ALT, and display both A and B sweeps on the screen.

(2) So set the horizontal POSITION knobs (44) and (45) that their white dots are positioned upward (noon position). So adjust the A SWEEP START (Figure 7-9, RV1003) that the start point of the A sweep is brought to the left hand end of the graticule.

(3) Next, with the B SWEEP START (Figure 7-9, RV1004), bring the start point of the B trace to left hand end of the graticule.

o Adjustment of × 10 MAG:

This adjustment is for calibration of the sweep time when the × 10 MAG switch (41) is turned on (pulled out). Before performing this adjustment, make sure that the adjustment for "Calibration of the A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 0.1 mS or a signal of 10 kHz and display the signal with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (41) in the CAL'D position and the TIME/DIV switch (39) at 1 mS.

(3) Turn on the × 10 MAG switch and so adjust the × 10 MAG GAIN ADJ (Figure 7-9, RV1005) that the displayed waveform conforms with scale divisions of the graticule.

o Calibration of DELAY TIME MULTI:

This calibration is for calibrating the dial value of the DELAY TIME MULTI to the sweep time. Before performing this calibration, make sure that the adjustment for "Calibration for A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 1 mS and display the waveform with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (41) in the CAL'D position, set the TIME/DIV switch (39) at 1 mS, set the TIME/DIV switch (40) at 10 µS, and change the DISPLAY switch (29) to the A INTEN state.

(3) Set the dial indication of the DELAY TIME MULTI at 1.00 and align the displayed waveform with the graticule.

(4) So adjust the DT START (Figure 7-9, RV704) that the accentuated portion of the waveform is aligned to the initial pulse as shown in Figure 7-7.

(5) Set the dial indication of the DELAY TIME MULTI at 10.00.

(6) So adjust the DT END (Figure 7-9, RV703) that the accentuated portion of the waveform is aligned to the 10th pulse.

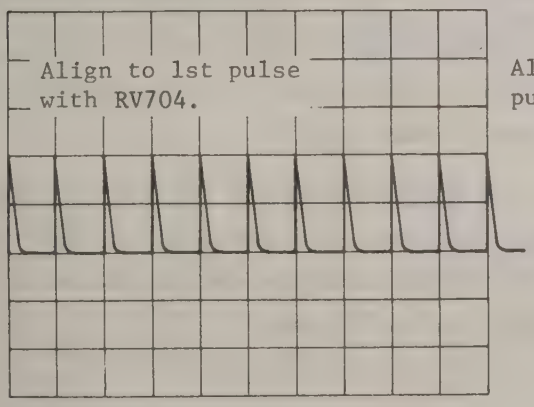


Figure 7-7

7.8 Adjustment of Horizontal Axis (X-axis)

o Calibration of horizontal sensitivity:

This adjustment is for calibration of the X-axis or CH3 HOR sensitivity for X-Y operation.

(1) Set at 100 mVp-p the output of the signal generator used for "Calibration of sensitivity" of section 7.5, and apply the output to the CH1 (X-axis) input terminal.

(2) Set the VERT MODE switch (26) in the X-Y state. Set the AC-GND-DC switch (13) of CH2 (Y-axis) at GND.

(3) Set the VARIABLE knob (22) at CAL'D and the VOLTS/DIV switch (23) at 10 mV.

(4) So adjust the CH1 & CH3 HOR GAIN (Figure 7-11, RV307) that the trace length becomes 10 DIV.

When this adjustment is done, the CH3 HOR sensitivity also is calibrated at the same time.

o Adjustment of CH1 & CH3 HOR POSITION:

This adjustment is to minimize the difference of trace positions between vertical-axis operation and horizontal-axis operation as controlled with the CH1 & CH3 POSITION controls (24) and (8).

(1) Set the VERT MODE switch (26) at CH1 and the AC-GND-DC switches (13) and (20) at GND.

(2) Move the trace to the center of the screen with the POSITION control knob (24).

(3) Next, turn the VERT MODE switch (26) to the X-Y position, and so adjust the CH1 & CH3 HOR POSITION CENT control (Figure 7-11, RV306) that the spot is placed in the center from the right and left ends.

7.9 Adjustment of Calibration Voltage

o Adjustment of repetition frequency:

This adjustment is for calibrating the repetition frequency of the calibration signal at 1 kHz.

(1) Connect the CALIB output (43) to a frequency counter.

(2) So adjust the CAL 1 kHz ADJ (Figure 7-10, RV1181) that the frequency counter 1 kHz.

o Calibration of the output voltage:

This adjustment is for calibrating the output voltage of the calibration signal in a substitution method.

(1) Set at 200 mVp-p the signal of the generator used for "calibration of sensitivity" of Section 7.5. Apply this signal to the CH1 input terminal.

(2) Display the signal on the screen with an amplitude of 8 DIV by adjusting the VOLTS/DIV switch (23) and VARIABLE knob (22).

(3) Apply the 200 mV CALIB output to the CH1 input terminal. So adjust the CAL OUTPUT LEVEL (Figure 7-10, RV1182) that the signal is displayed with an amplitude of 8 DIV on the screen in the same manner as step (2) above.

This completes the CAL voltage adjustment procedure.

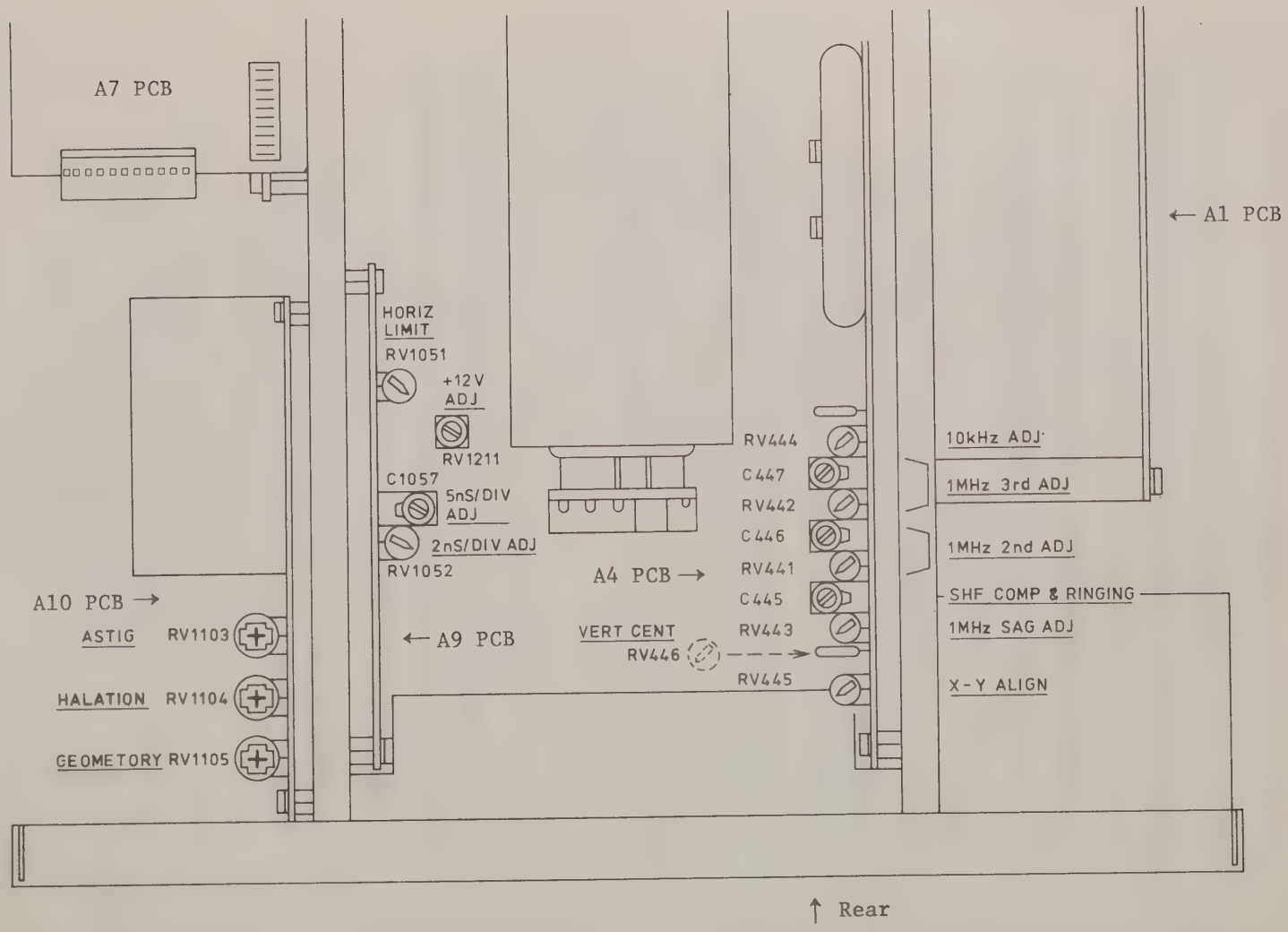


Figure 7-8 (Top view)

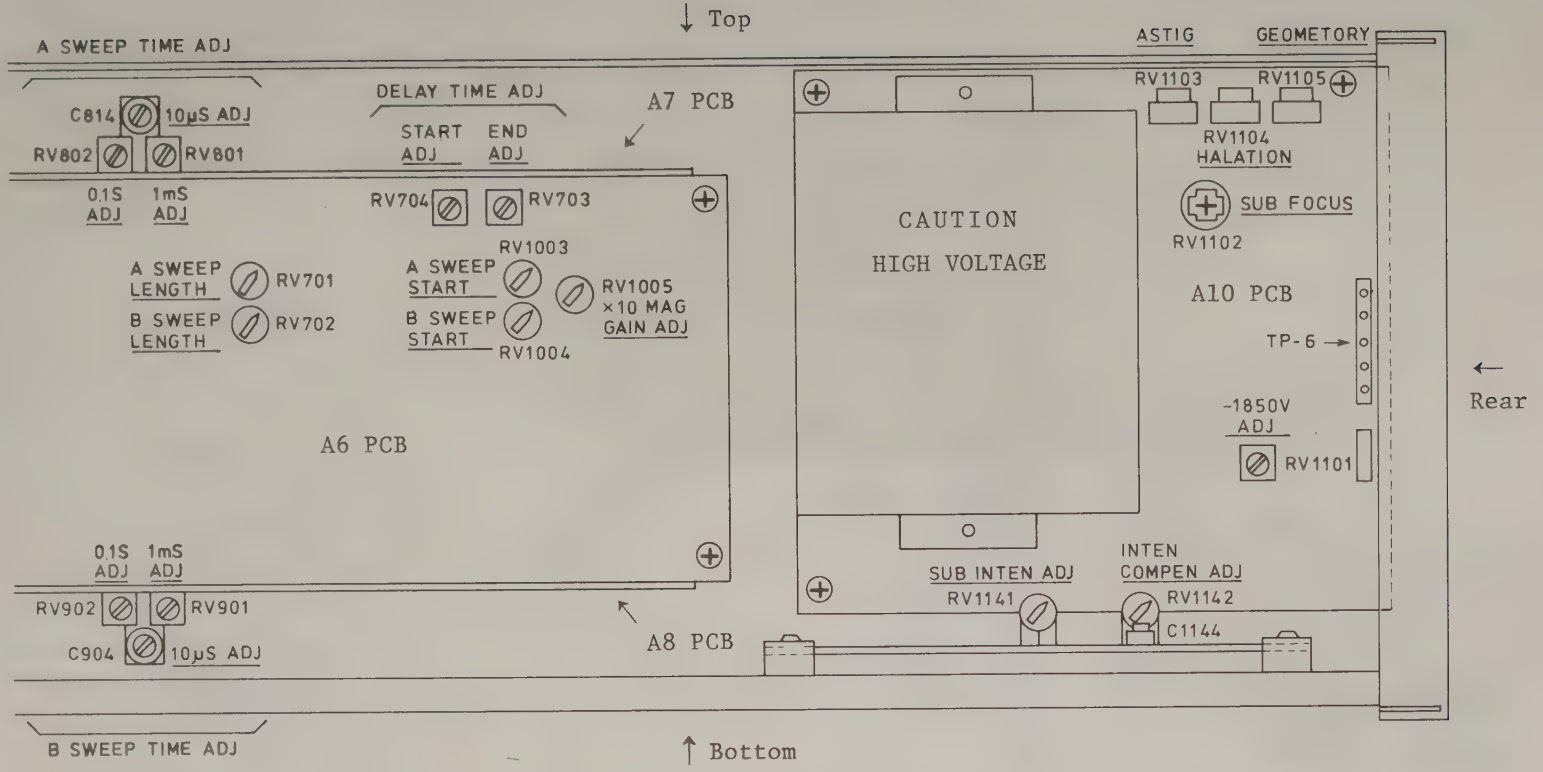


Figure 7-9 (Right hand side view)

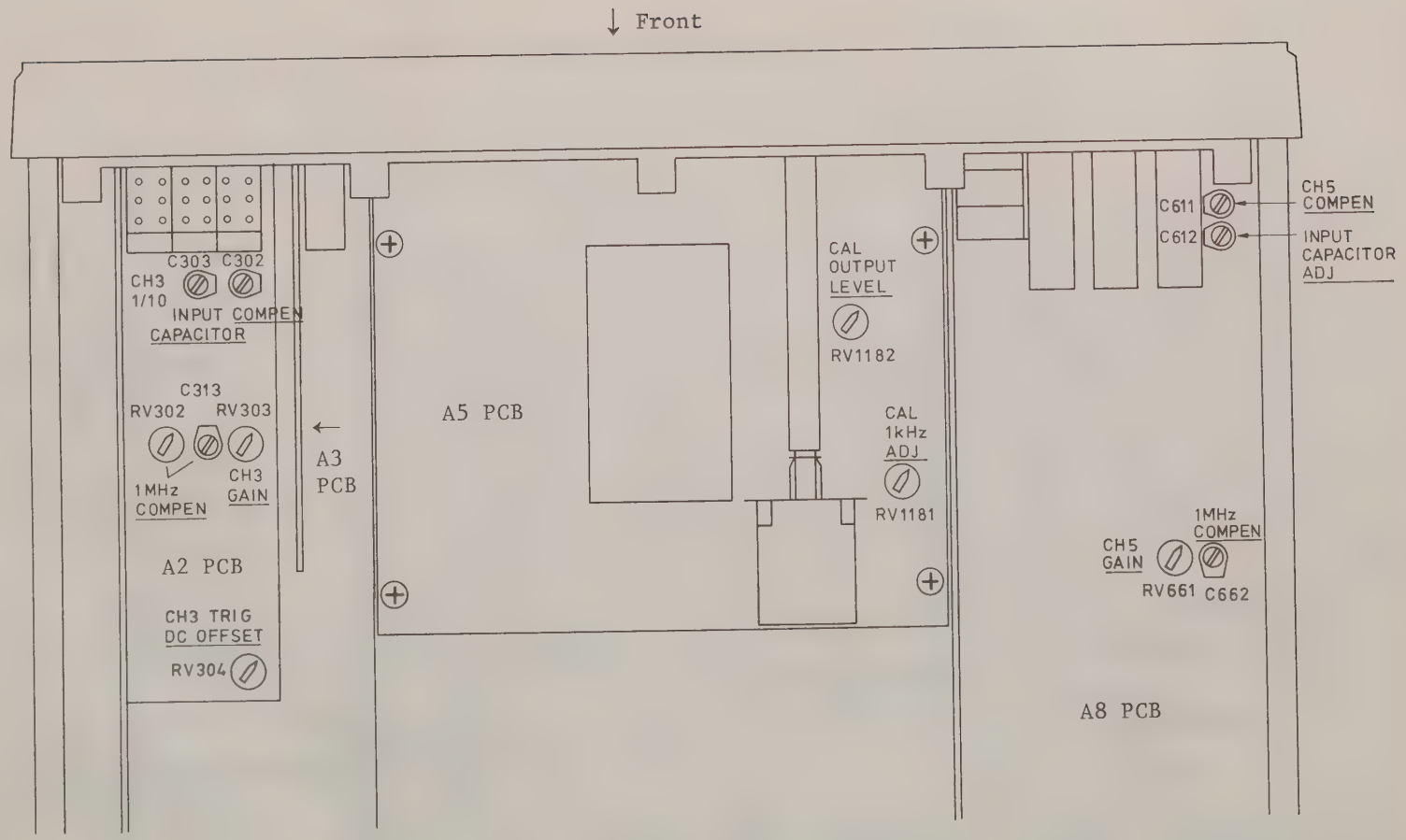


Figure 7-10 (Bottom view)

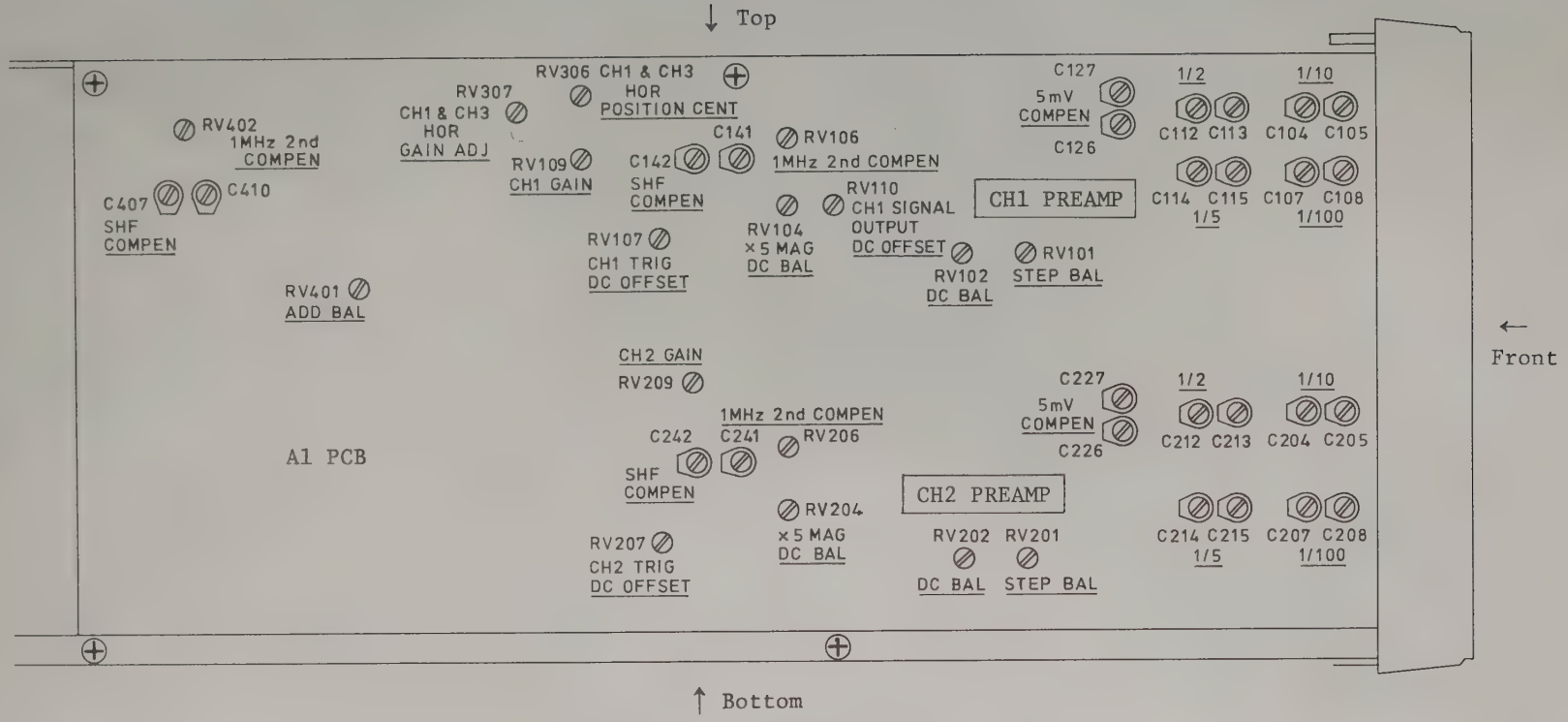


Figure 7-11 (Left hand side view)

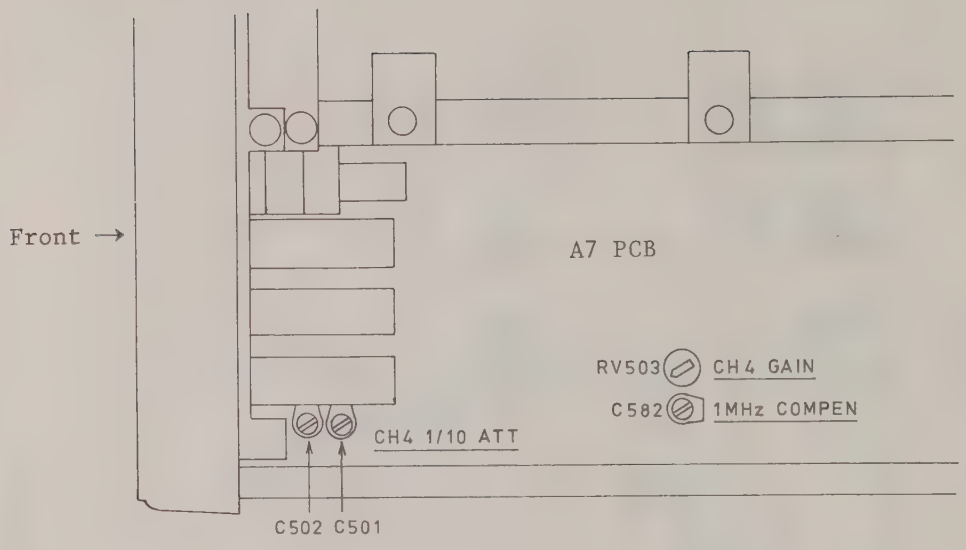
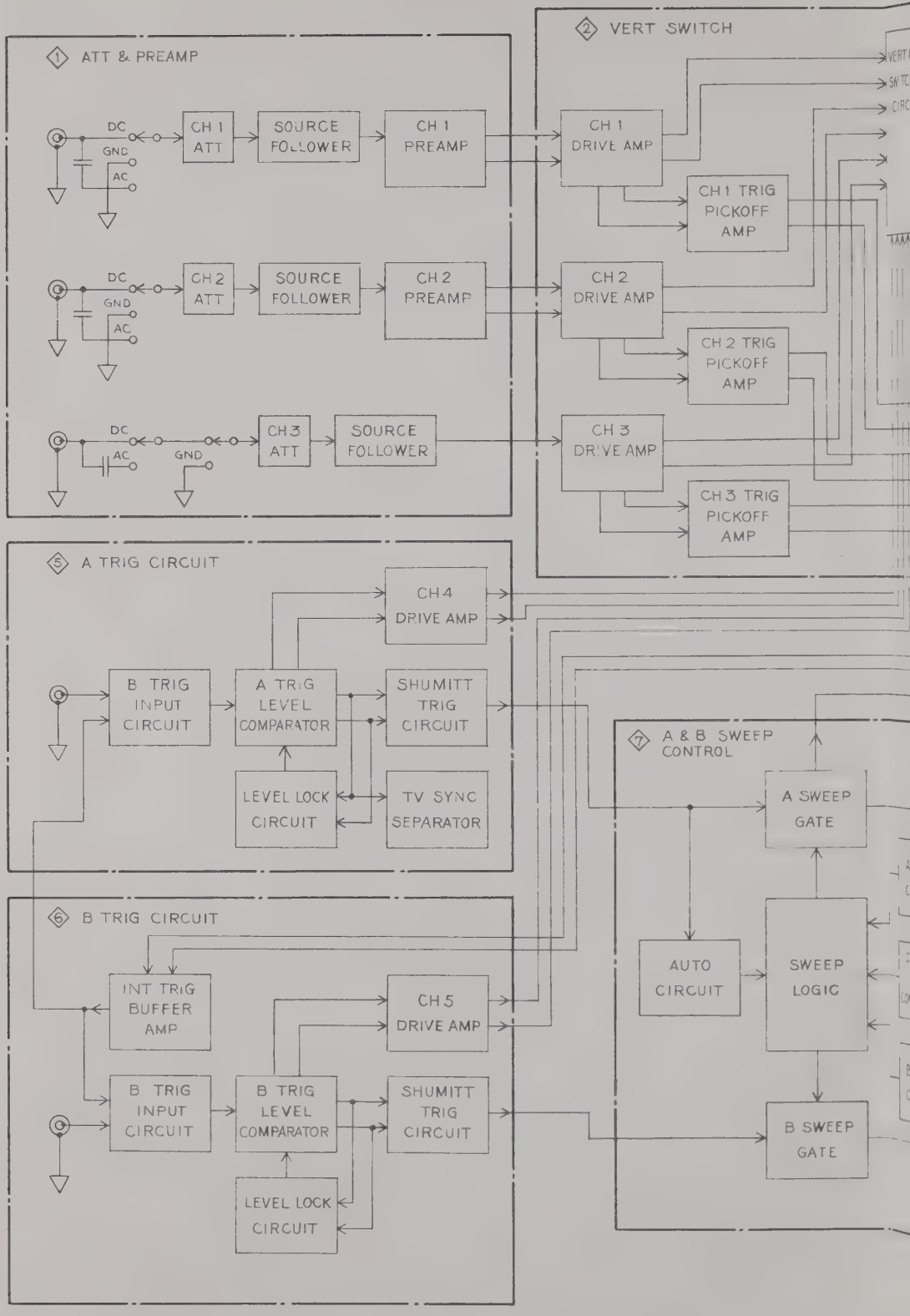
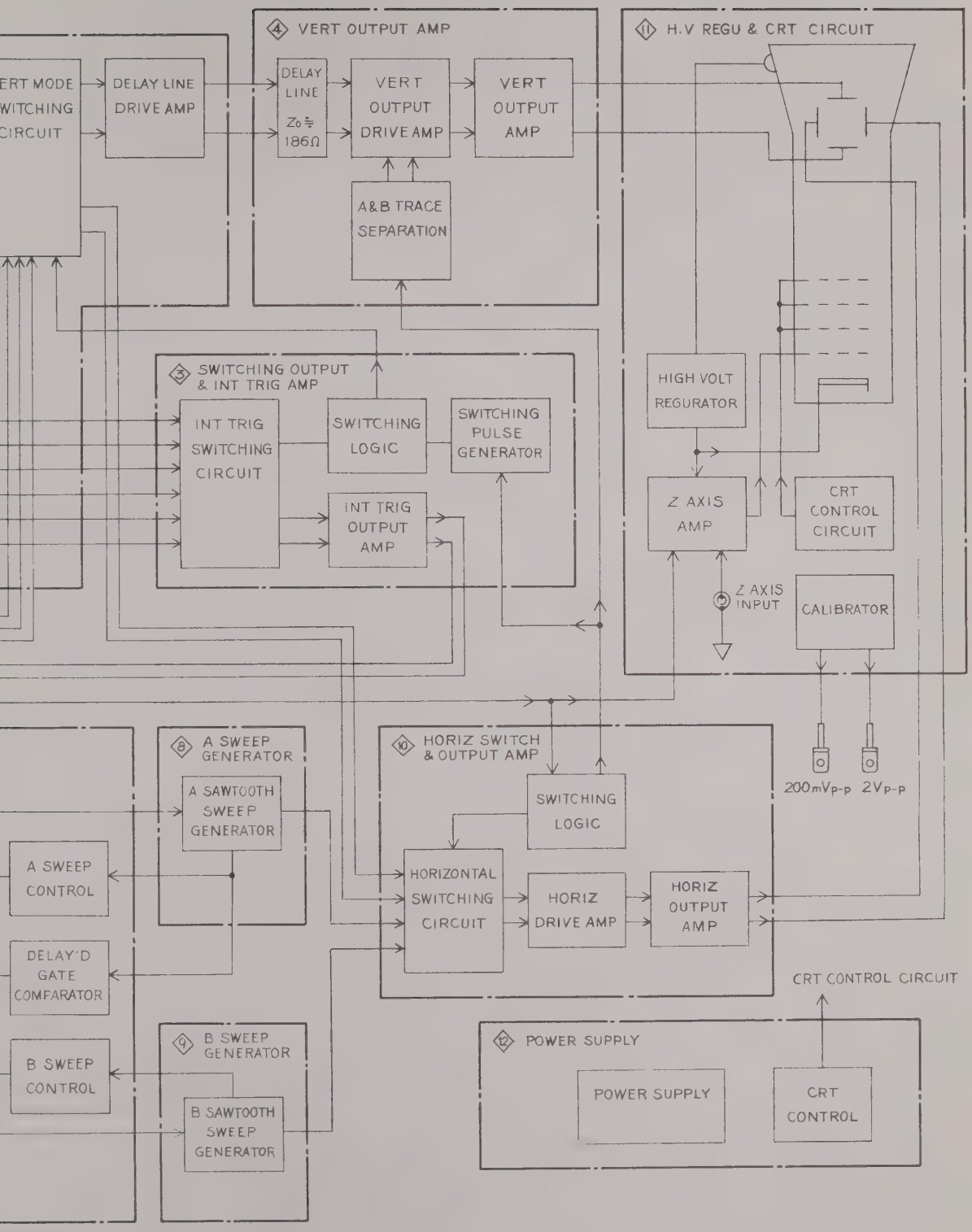


Figure 7-12 (Bottom view)


1 ATT & PREAMP
DC
GND
AC
CH 1 ATT
SOURCE FOLLOWER
CH 1 PREAMP
CH 2 ATT
SOURCE FOLLOWER
CH 2 PREAMP
CH 3 ATT
SOURCE FOLLOWER
2 VERT SWITCH
CH 1 DRIVE AMP
CH 1 TRIG PICKOFF AMP
CH 2 DRIVE AMP
CH 2 TRIG PICKOFF AMP
CH 3 DRIVE AMP
CH 3 TRIG PICKOFF AMP
5 A TRIG CIRCUIT
CH 4 DRIVE AMP
B TRIG INPUT CIRCUIT
A TRIG LEVEL COMPARATOR
SHUMITT TRIG CIRCUIT
LEVEL LOCK CIRCUIT
TV SYNC SEPARATOR
6 B TRIG CIRCUIT
INT TRIG BUFFER AMP
CH 5 DRIVE AMP
B TRIG INPUT CIRCUIT
B TRIG LEVEL COMPARATOR
SHUMITT TRIG CIRCUIT
LEVEL LOCK CIRCUIT
7 A & B SWEEP CONTROL
A SWEEP GATE
AUTO CIRCUIT
SWEEP LOGIC
B SWEEP GATE



MODEL COS6100 BLOCK DIAGRAM

CIRCUIT SCHEMATICS

◇1 ATT & PREAMP

◇2 VERT SWITCH

◇3 SWITCHING CIRCUIT & INT TRIG AMP

◇4 VERT OUTPUT AMP

◇5 A TRIG CIRCUIT

◇6 B TRIG CIRCUIT

◇7 A/B SWEEP CONTROL

◇8 A SWEEP GENERATOR

◇9 B SWEEP GENERATOR

◇10 HOR SWITCH & OUTPUT AMP

◇11 HV REGU & CRT CIRCUIT

◇12 POWER SUPPLY & CRT CONTROL

NOTES

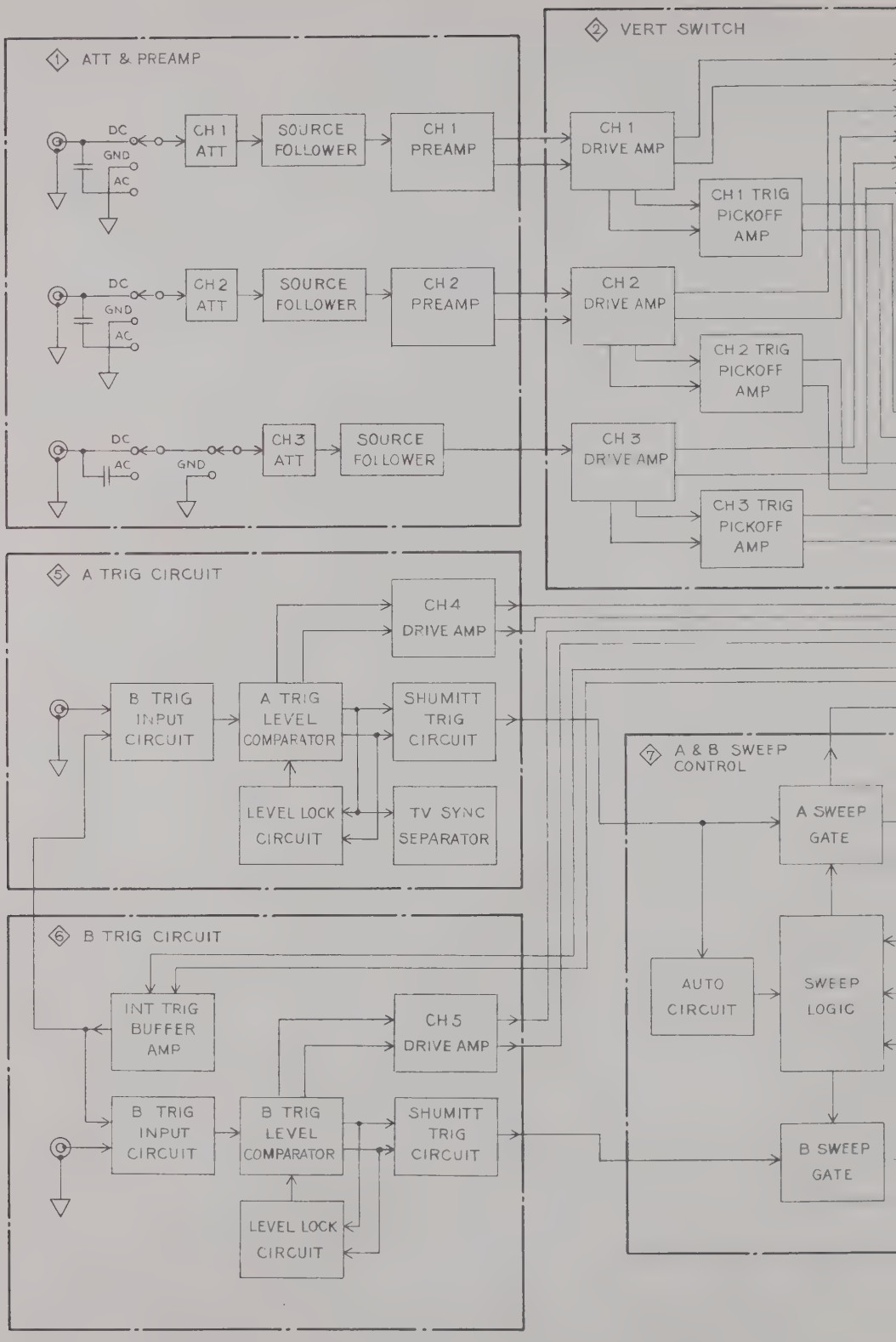
Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.

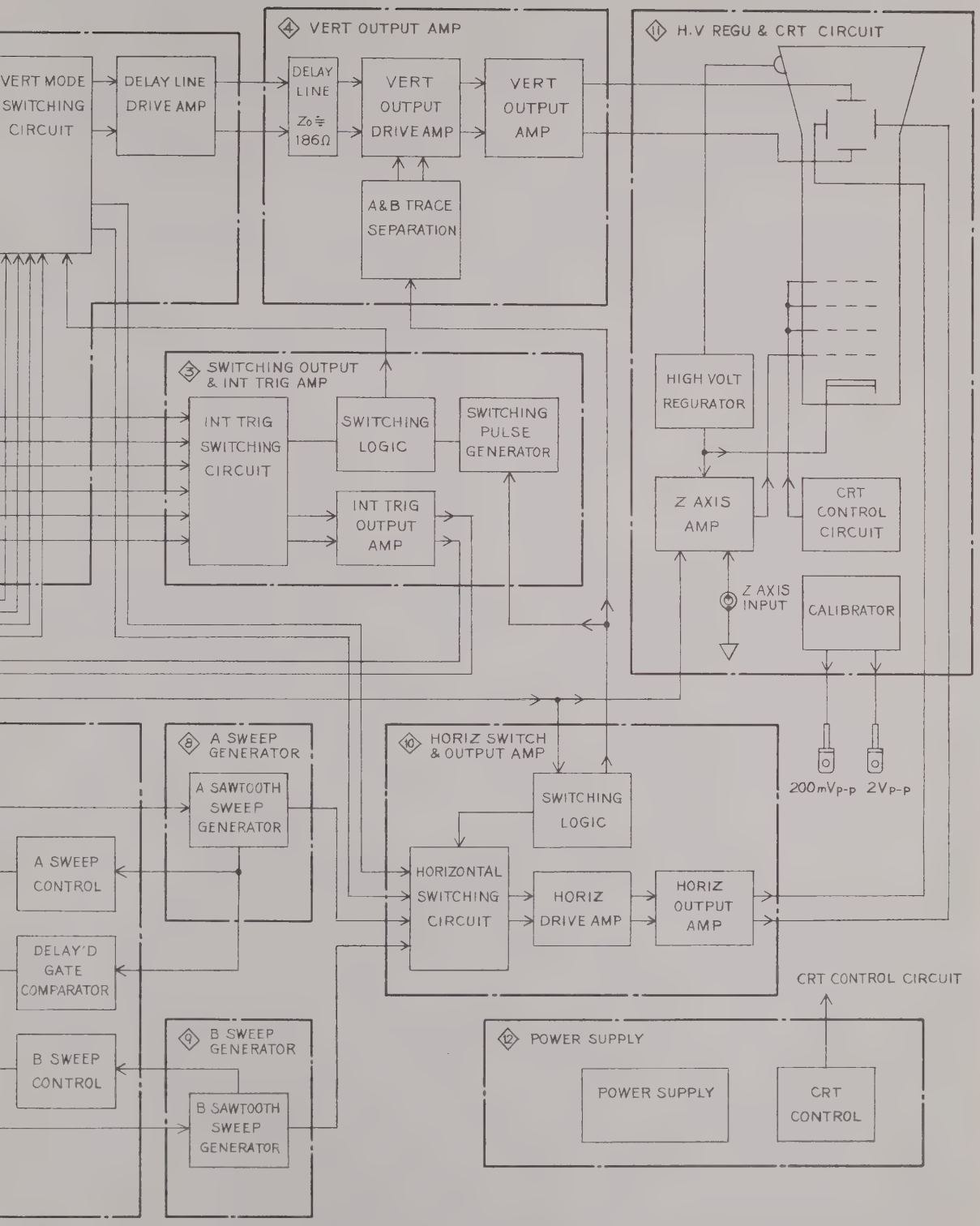
* Optimum value selected at factory. Average value shown.

(Parts may be omitted.)

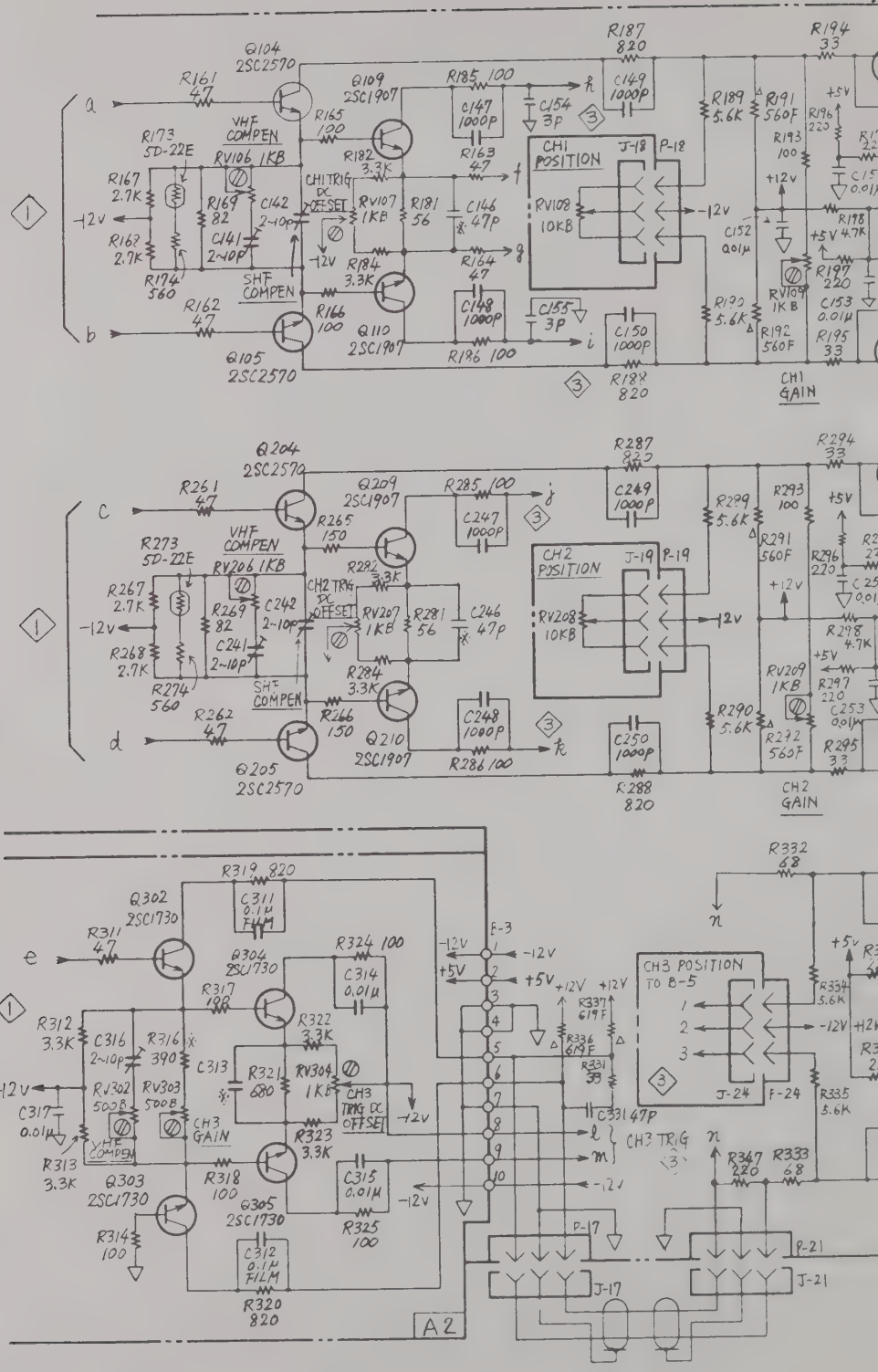
△ Metal film resistor.

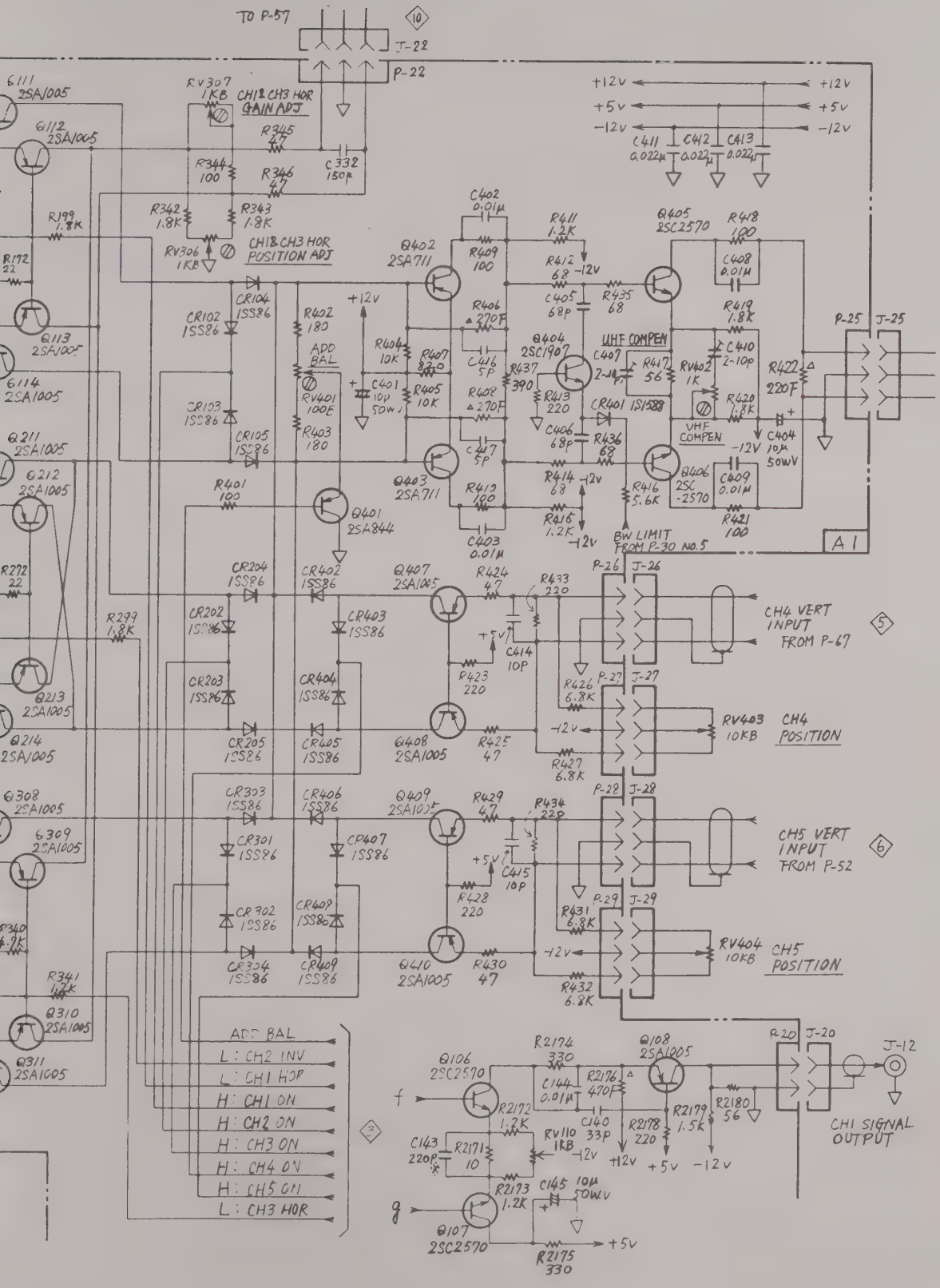
⊘ Screwdriver adjustment.


1 ATT & PREAMP
DC
GND
AC
CH 1 ATT
SOURCE FOLLOWER
CH 1 PREAMP
DC
GND
AC
CH 2 ATT
SOURCE FOLLOWER
CH 2 PREAMP
DC
AC
GND
CH 3 ATT
SOURCE FOLLOWER
2 VERT SWITCH
CH 1 DRIVE AMP
CH 1 TRIG PICKOFF AMP
CH 2 DRIVE AMP
CH 2 TRIG PICKOFF AMP
CH 3 DRIVE AMP
CH 3 TRIG PICKOFF AMP
5 A TRIG CIRCUIT
CH 4 DRIVE AMP
B TRIG INPUT CIRCUIT
A TRIG LEVEL COMPARATOR
SHUMITT TRIG CIRCUIT
LEVEL LOCK CIRCUIT
TV SYNC SEPARATOR
7 A & B SWEEP CONTROL
A SWEEP GATE
AUTO CIRCUIT
SWEEP LOGIC
B SWEEP GATE
6 B TRIG CIRCUIT
INT TRIG BUFFER AMP
CH 5 DRIVE AMP
B TRIG INPUT CIRCUIT
B TRIG LEVEL COMPARATOR
SHUMITT TRIG CIRCUIT
LEVEL LOCK CIRCUIT

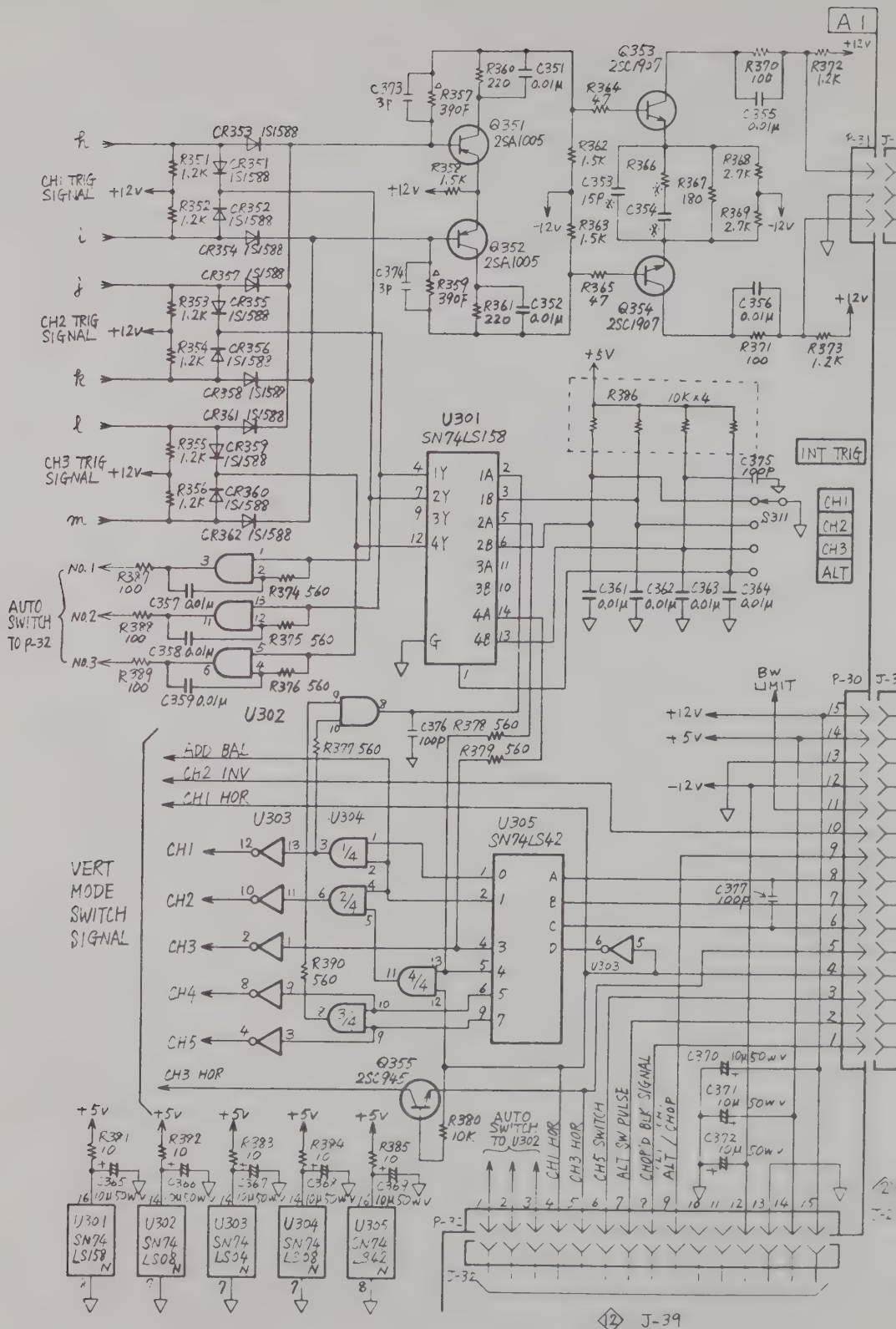


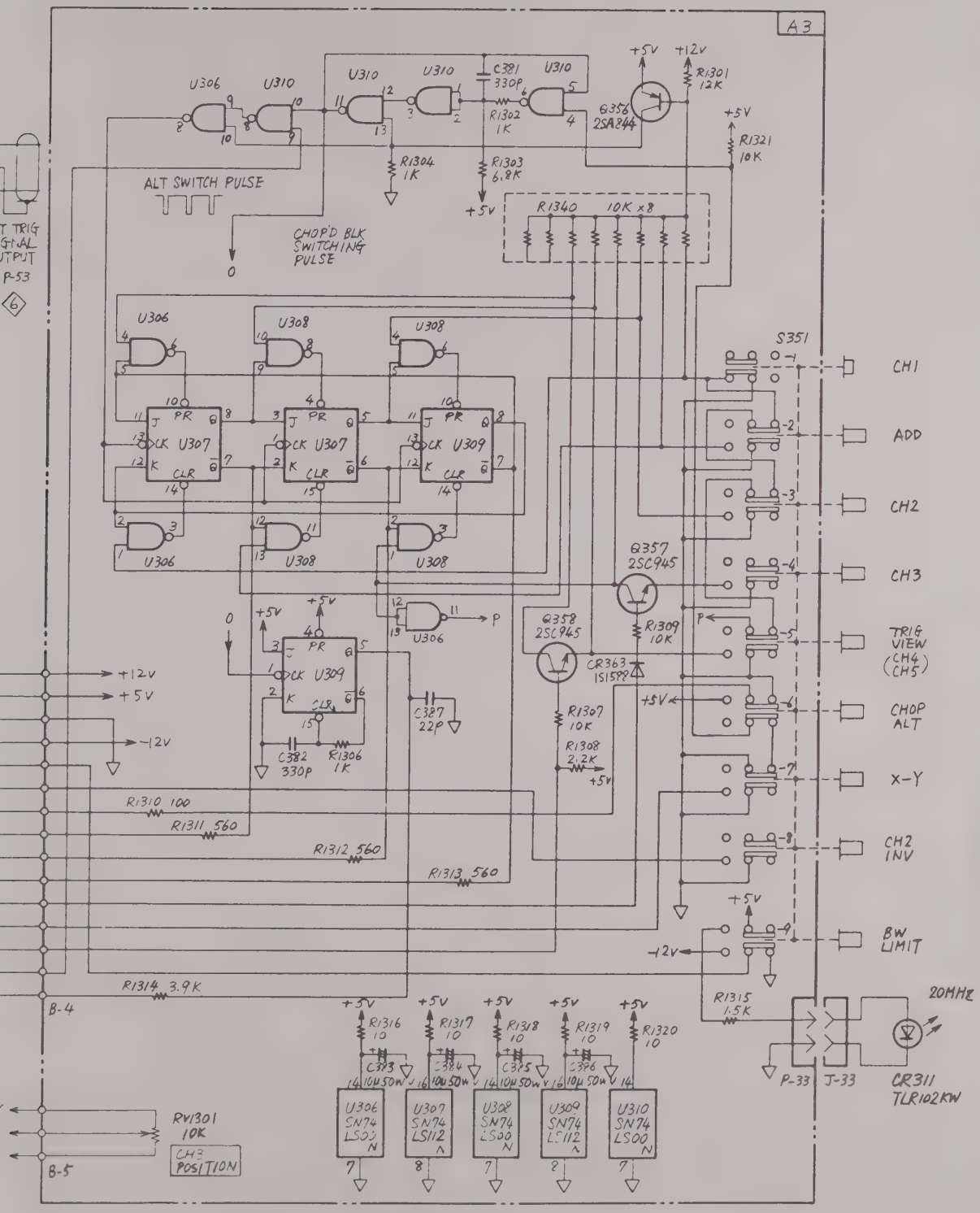
MODEL COS6100 BLOCK DIAGRAM


Q104 2SC2570
R161 47
R165 100
VHF COMPEN
R173 5D-22E
RV106 1KB
R167 2.7K
R169 82
C142 2~10P
C141 2~10P
R163 2.7K
R174 560
SHF COMPEN
R162 47
R166 100
Q105 2SC2570
Q109 2SC1907
R185 100
C147 1000P
R182 3.3K
R181 56
C146 47P
R184 3.3K
R164 47
C148 1000P
R196 100
Q110 2SC1907
C154 3P
C155 3P
CH1 TRIG DC OFFSET
RV107 1KB
CH1 POSITION
J-18
P-18
RV108 10KB
R187 820
C149 1000P
C150 1000P
R188 820
R189 5.6K
R190 5.6K
C152 0.01μ
RV109 1KB
R191 560F
R192 560F
R193 100
R194 33
R195 33
R196 220
R197 220
R198 4.7K
C153 0.01μ
+5V
+12V
-12V
CH1 GAIN
Q204 2SC2570
R261 47
R265 150
VHF COMPEN
R273 5D-22E
RV206 1KB
R267 2.7K
R269 82
C242 2~10P
C241 2~10P
R268 2.7K
R274 560
SHF COMPEN
R262 47
R266 150
Q205 2SC2570
Q209 2SC1907
R285 100
C247 1000P
R282 3.3K
R281 56
C246 47P
R284 3.3K
C248 1000P
R286 100
Q210 2SC1907
CH2 TRIG DC OFFSET
RV207 1KB
CH2 POSITION
J-19
P-19
RV208 10KB
R287 820
C249 1000P
C250 1000P
R288 820
R289 5.6K
R290 5.6K
RV209 1KB
R291 560F
R292 560F
R293 100
R294 33
R295 33
R296 220
R297 220
R298 4.7K
C253 0.01μ
CH2 GAIN
Q302 2SC1730
R311 47
R319 820
C311 0.1μ FILM
R324 100
C314 0.01μ
Q304 2SC1730
R317 180
R322 3.3K
R312 3.3K
C316 2~10P
R316 390
C313
R321 680
RV304 1KB
CH3 TRIG DC OFFSET
RV302 500B
RV303 500B
C317 0.01μ
VHF COMPEN
CH3 GAIN
R313 3.3K
R323 3.3K
Q303 2SC1730
R318 100
Q305 2SC1730
C315 0.01μ
R325 100
R314 100
C312 0.1μ FILM
R320 820
A2
F-3
CH3 POSITION TO B-5
J-24
F-24
R336 619F
R337 619F
R331 33
C331 47P
CH3 TRIG
R332 68
R334 5.6K
R335 5.6K
R347 220
R333 68
P-17
P-21
J-17
J-21

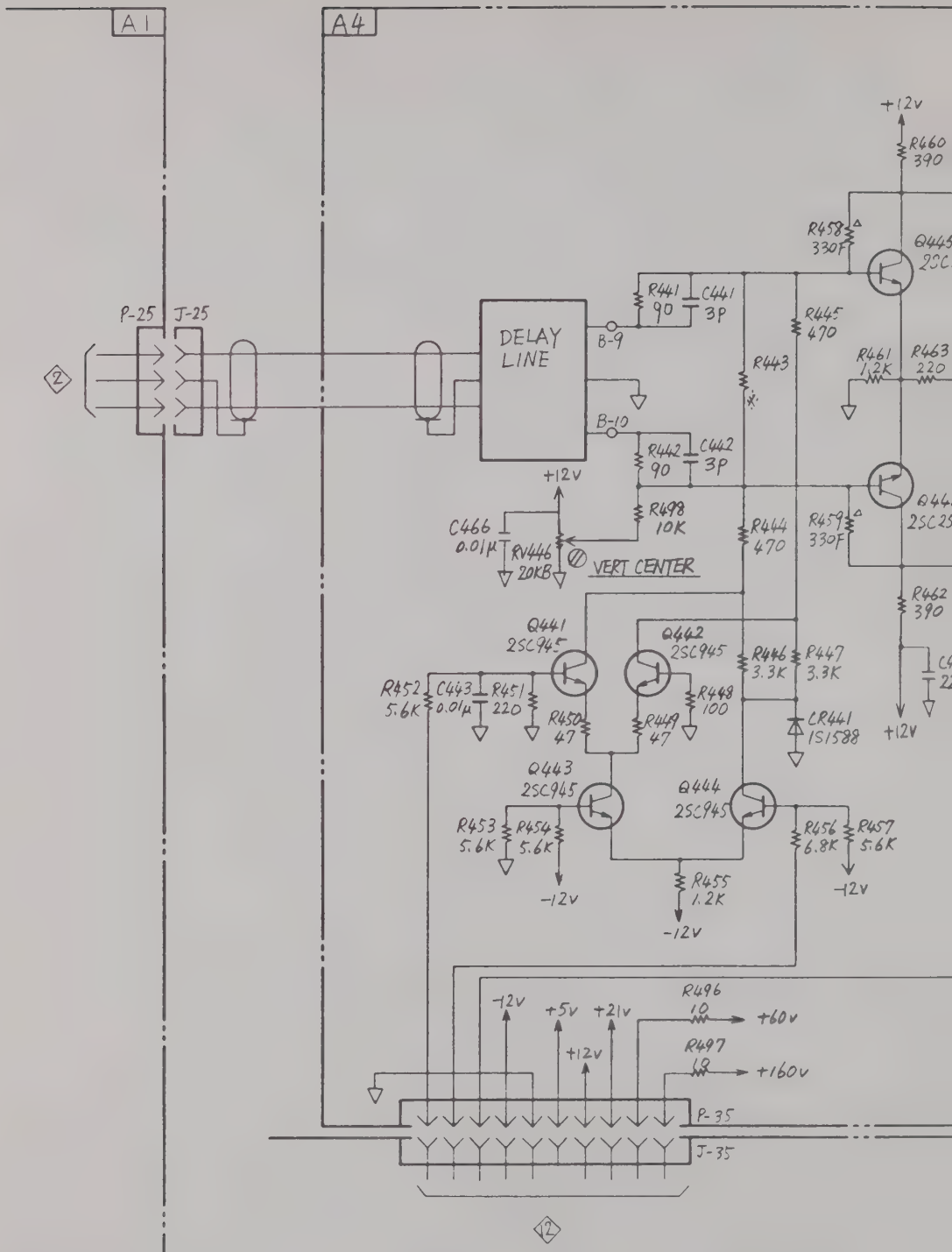


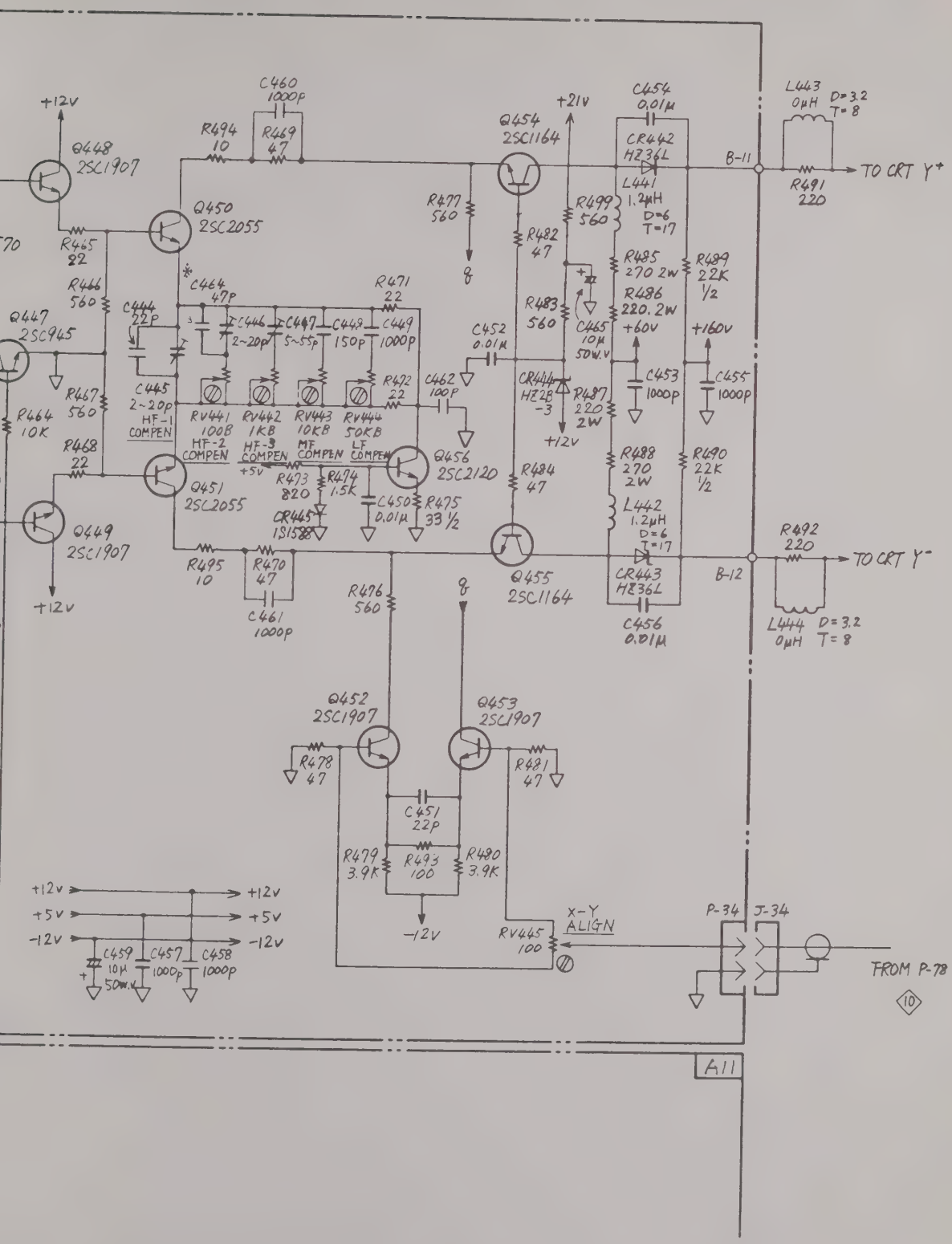
2 VERT SWITCH


A1
CH1 TRIG SIGNAL
CH2 TRIG SIGNAL
CH3 TRIG SIGNAL
+12V
-12V
+5V
CR353 1S1588
CR354 1S1588
CR355 1S1588
CR356 1S1588
CR357 1S1588
CR358 1S1588
CR359 1S1588
CR360 1S1588
CR361 1S1588
CR362 1S1588
R351 1.2K
R352 1.2K
R353 1.2K
R354 1.2K
R355 1.2K
R356 1.2K
Q351 2SA1005
Q352 2SA1005
Q353 2SC1907
Q354 2SC1907
Q355 2SC945
R357 390F
R358 1.5K
R359 390F
R360 220
R361 220
R362 1.5K
R363 1.5K
R364 47
R365 47
R366
R367 180
R368 2.7K
R369 2.7K
R370 100
R371 100
R372 1.2K
R373 1.2K
C351 0.01μ
C352 0.01μ
C353 15P
C354
C355 0.01μ
C356 0.01μ
C373 3P
C374 3P
U301
SN74LS158
1Y
2Y
3Y
4Y
1A
1B
2A
2B
3A
3B
4A
4B
G
R386 10K×4
C375 100P
INT TRIG
S311
CH1
CH2
CH3
ALT
C361 0.01μ
C362 0.01μ
C363 0.01μ
C364 0.01μ
AUTO SWITCH TO P-32
NO.1
NO.2
NO.3
R387 100
R388 100
R389 100
R374 560
R375 560
R376 560
C357 0.01μ
C358 0.01μ
C359 0.01μ
U302
R377 560
C376 100P
R378 560
R379 560
ADD BAL
CH2 INV
CH1 HOR
U303
U304
U305
SN74LS42
VERT MODE SWITCH SIGNAL
CH1
CH2
CH3
CH4
CH5
CH3 HOR
R390 560
C377 100P
BW LIMIT
P-30
P-31
P-32
J-32
R380 10K
AUTO SWITCH TO U302
CH1 HOR
CH3 HOR
CH5 SWITCH
ALT SW PULSE
CHOP'D BLK SIGNAL
ALT / CHOP
C370 10μ 50WV
C371 10μ 50WV
C372 10μ 50WV
R391 10
R392 10
R393 10
R394 10
R395 10
C365 10μ 50WV
C366 10μ 50WV
C367 10μ 50WV
C368 10μ 50WV
C369 10μ 50WV
U301 SN74LS158N
U302 SN74LS08N
U303 SN74LS04N
U304 SN74LS08N
U305 SN74LS42N
J-39

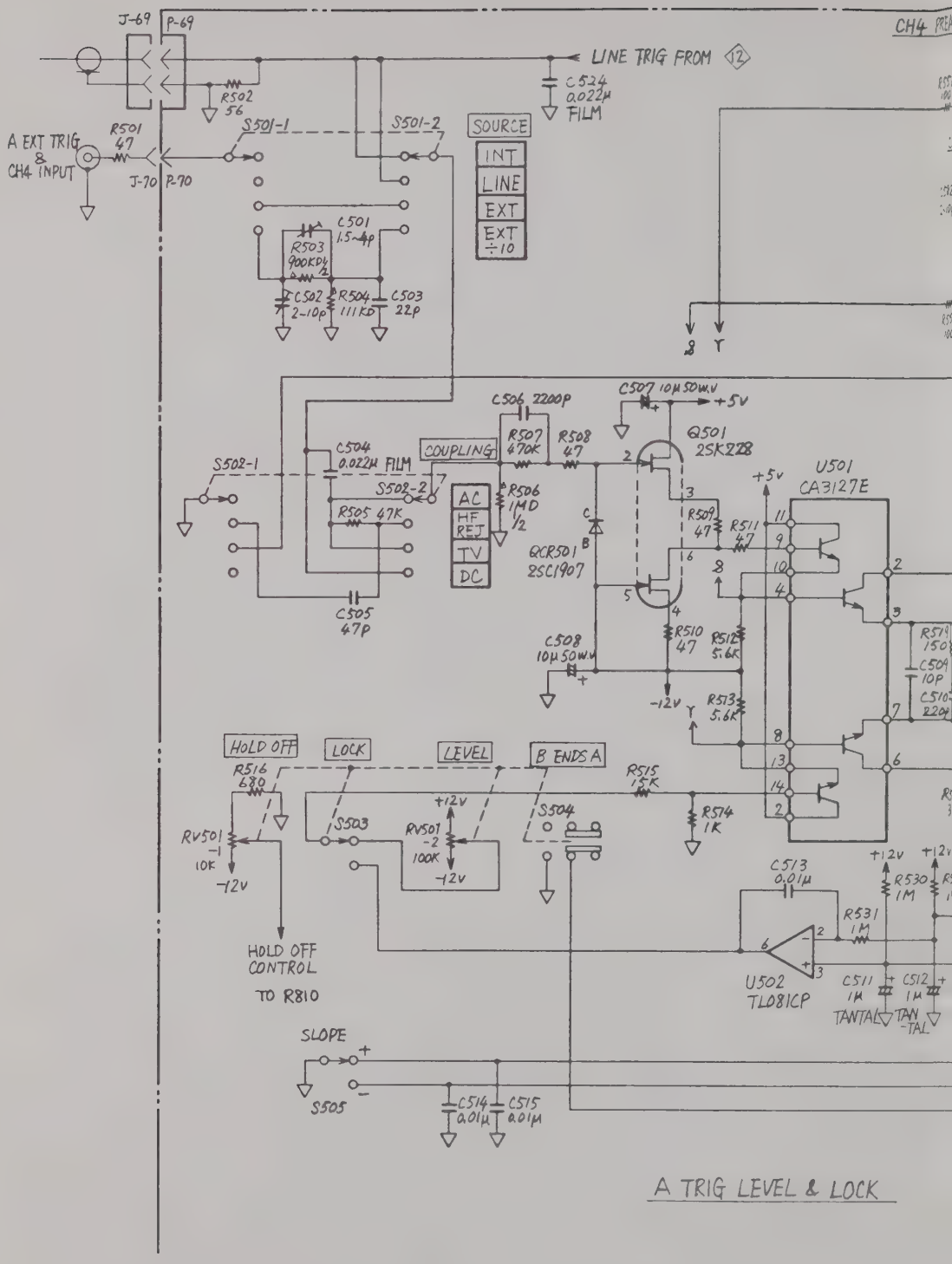


3 SWITCHING CIRCUIT & INT TRIG AMP

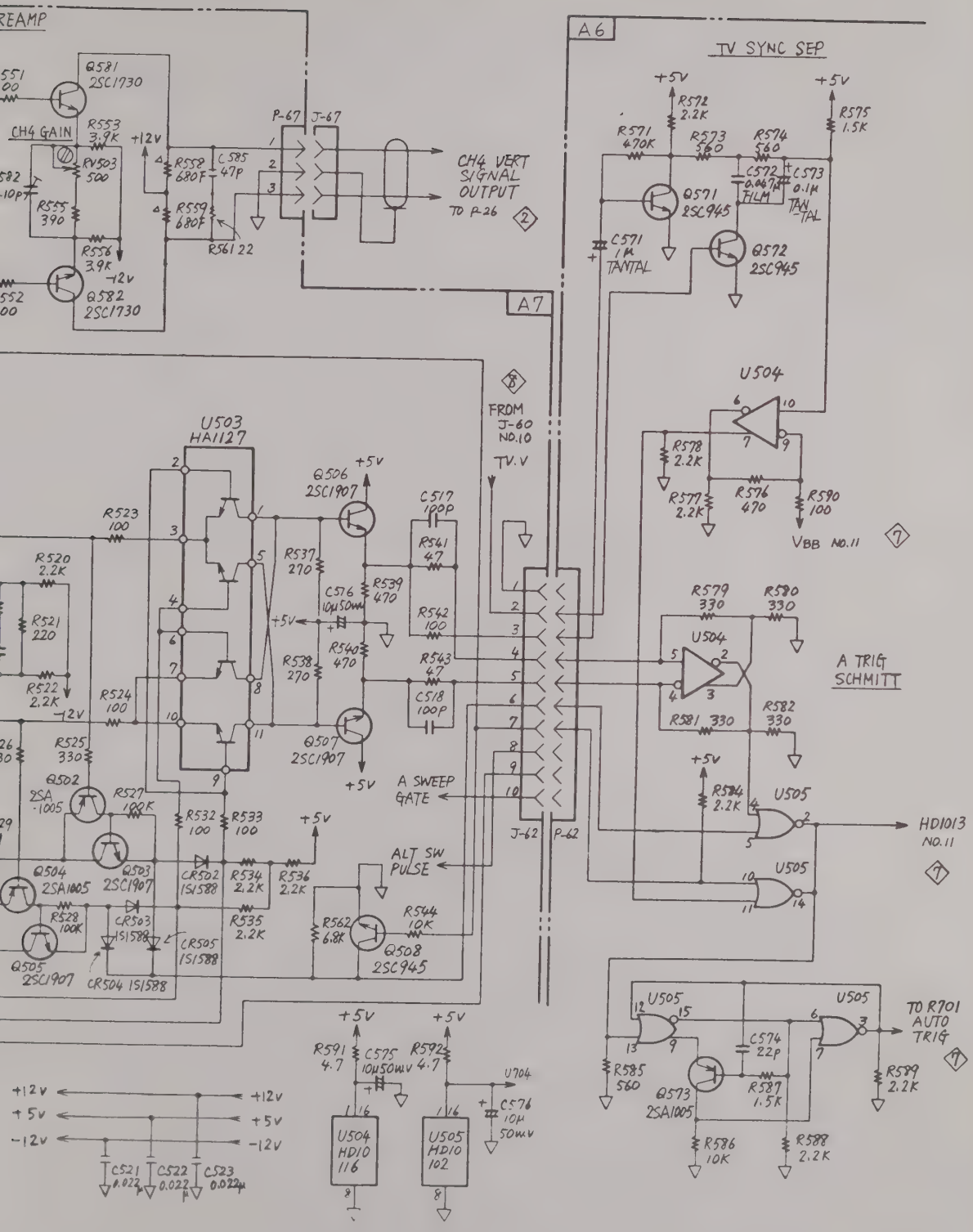

A1
A4
P-25
J-25
DELAY LINE
B-9
B-10
R441 90
C441 3P
R442 90
C442 3P
R443
R445 470
R444 470
R460 390
R458 330F
R459 330F
R461 1.2K
R463 220
R462 390
+12v
C466 0.01μ
RV446 20KB
VERT CENTER
R498 10K
Q441 2SC945
Q442 2SC945
Q443 2SC945
Q444 2SC945
R452 5.6K
C443 0.01μ
R451 220
R450 47
R449 47
R448 100
R446 3.3K
R447 3.3K
CR441 1S1588
R453 5.6K
R454 5.6K
R455 1.2K
R456 6.8K
R457 5.6K
-12v
-12v
-12v
+5v
+21v
+12v
R496 10
R497 68
+60v
+160v
P-35
J-35



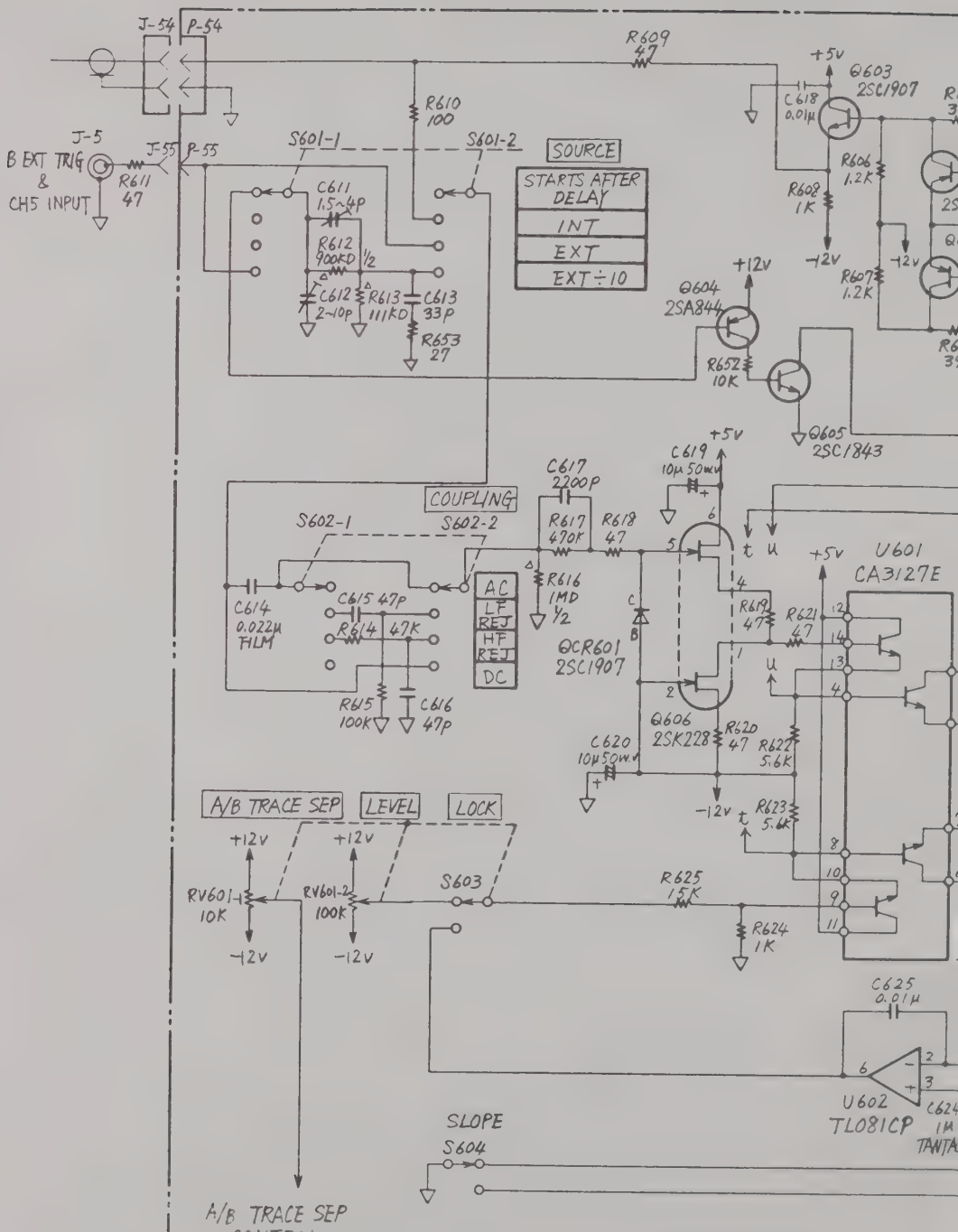
4 VERT OUTPUT AMP

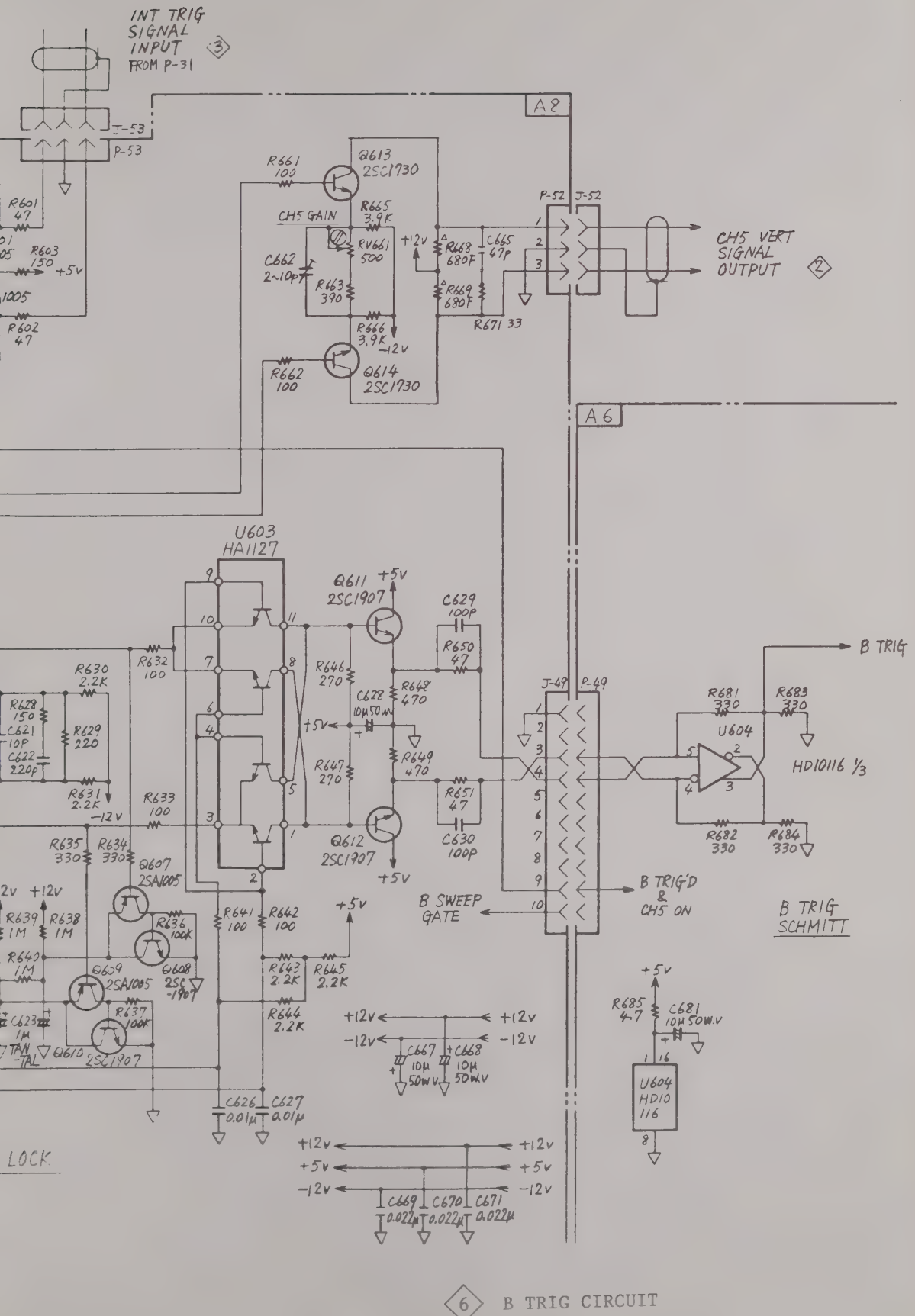


A TRIG LEVEL & LOCK

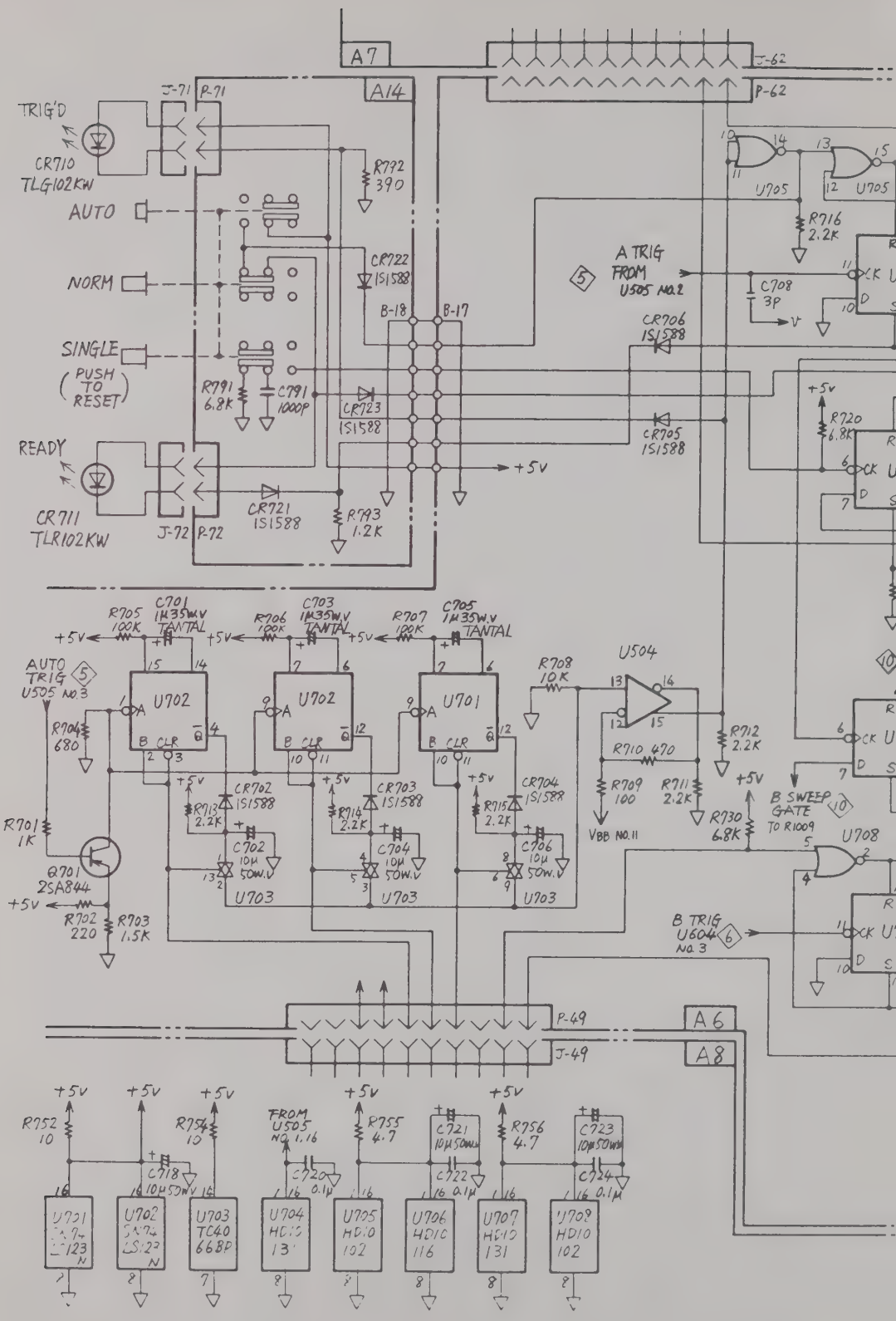


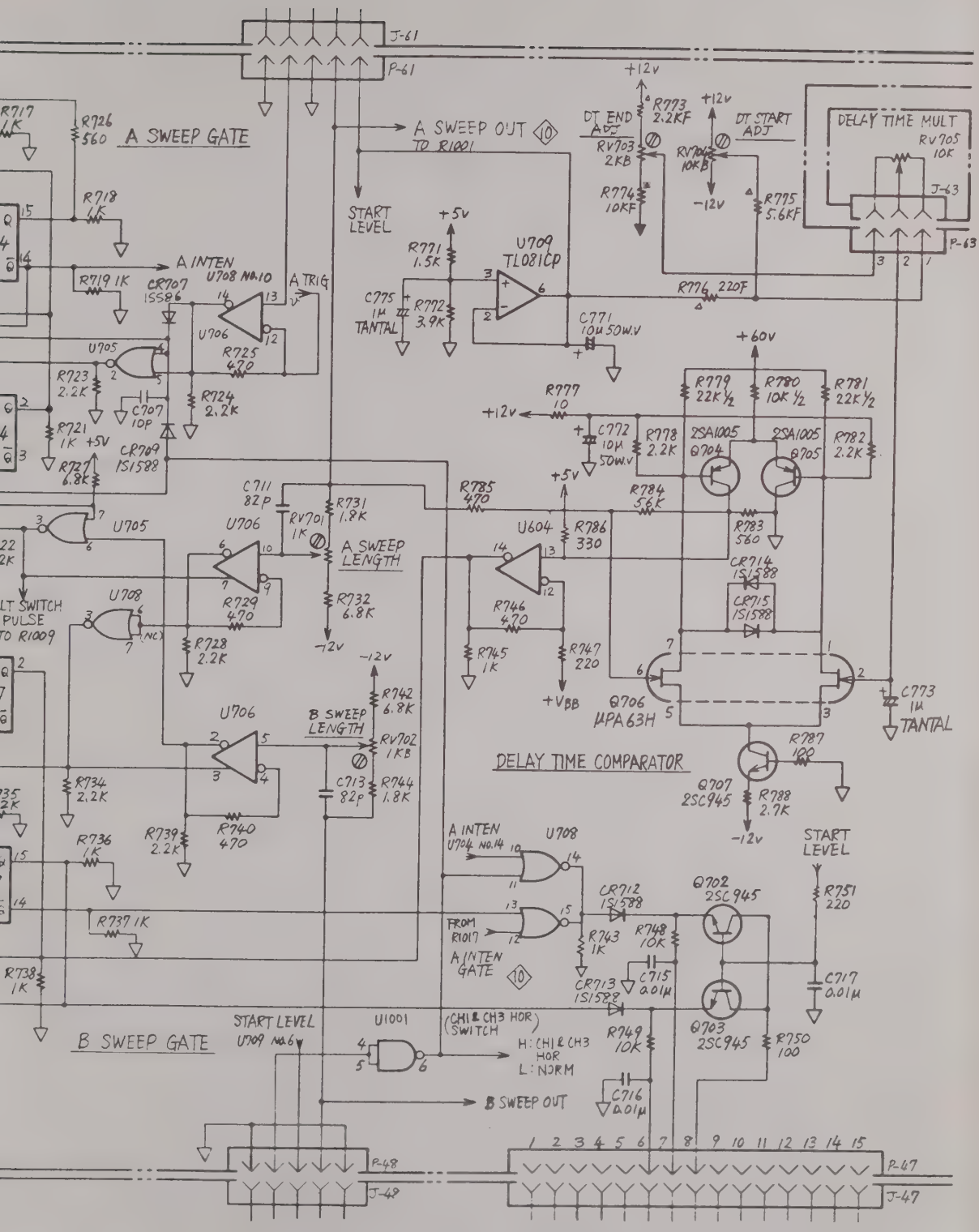
5 A TRIG CIRCUIT


J-54
P-54
R609
47
+5V
Q603
2SC1907
C618
0.01μ
R610
100
J-5
B EXT TRIG
&
CH5 INPUT
R611
47
J-55
P-55
S601-1
S601-2
SOURCE
STARTS AFTER DELAY
INT
EXT
EXT÷10
C611
1.5~4P
R612
900KΩ 1/2
C612
2~10P
R613
111KΩ
C613
33P
R653
27
R606
1.2K
R608
1K
-12V
+12V
R607
1.2K
Q604
2SA844
R652
10K
Q605
2SC1843
C619
10μ 50WV
C617
2200P
COUPLING
S602-1
S602-2
R617
470K
R618
47
AC
LF REJ
HF REJ
DC
R616
1MΩ 1/2
C614
0.022μ
FILM
C615 47P
R614 47K
R615
100K
C616
47P
QCR601
2SC1907
U601
CA3127E
R619
47
R621
47
Q606
2SK228
R620
47
R622
5.6K
C620
10μ 50WV
R623
5.6K
A/B TRACE SEP
LEVEL
LOCK
RV601-1
10K
RV601-2
100K
S603
R625
15K
R624
1K
C625
0.01μ
U602
TL081CP
C624
1M
TANTA
SLOPE
S604
A/B TRACE SEP
CONTROL
TO J-43
NO. 8
B TRIG LEVEL

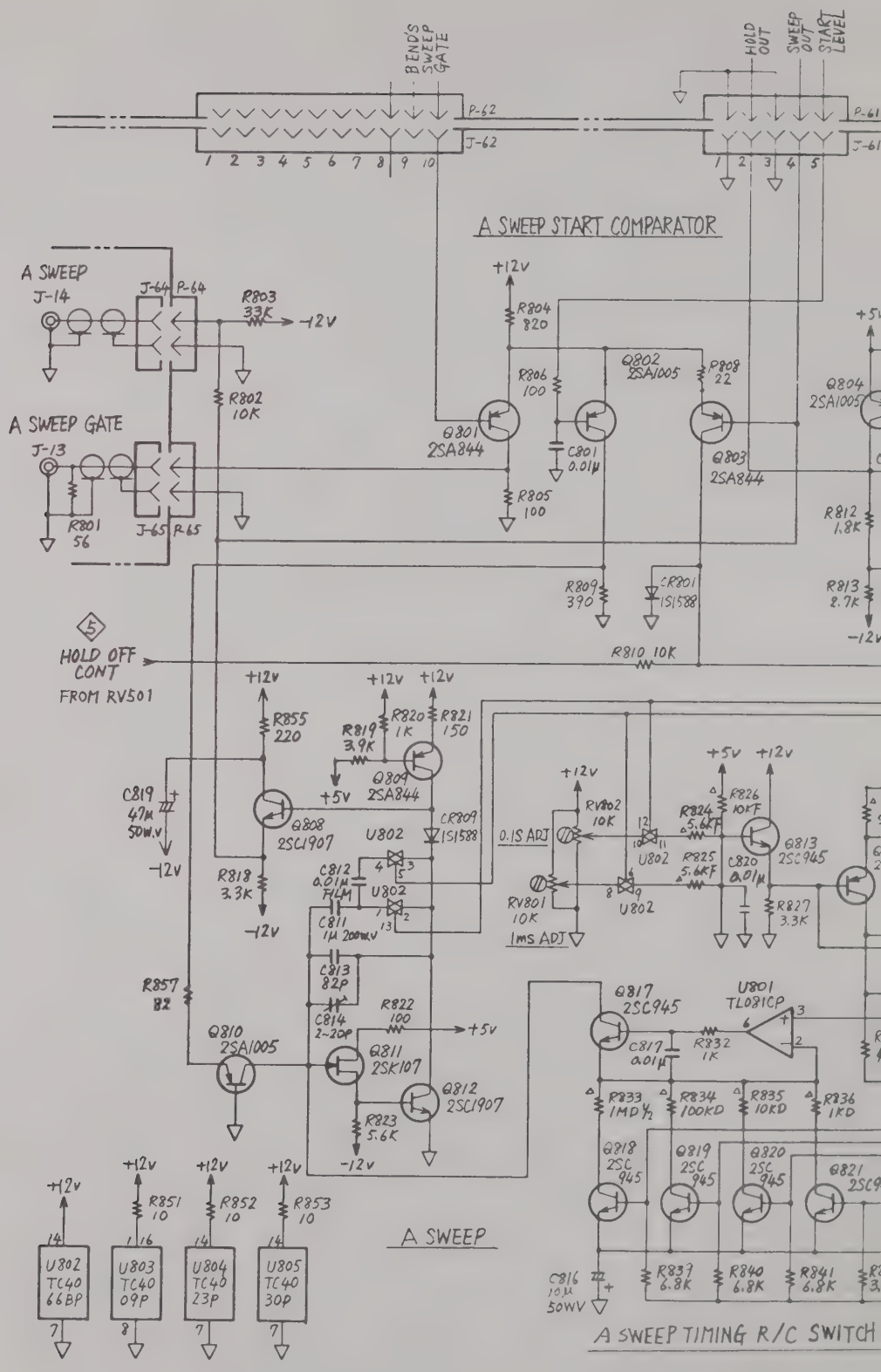


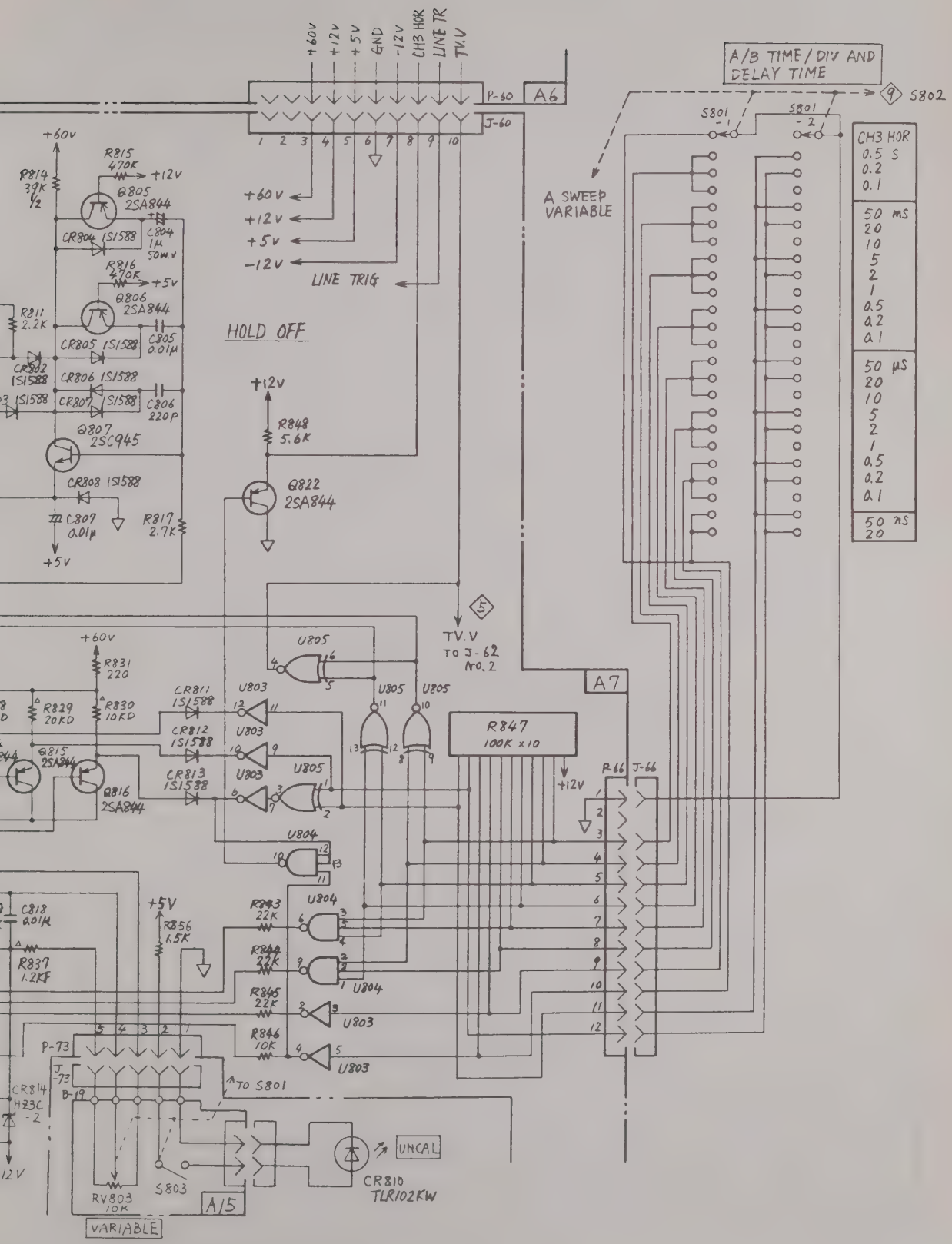
6 B TRIG CIRCUIT


A7
J-62
P-62
A14
J-71
P-71
TRIG'D
CR710
TLG102KW
AUTO
NORM
SINGLE
(PUSH TO RESET)
READY
CR711
TLR102KW
J-72
P-72
R792 390
CR722 1S1588
B-18
B-17
R791 6.8K
C791 1000P
CR723 1S1588
CR721 1S1588
R793 1.2K
+5V
U705
R716 2.2K
A TRIG FROM U505 NO.2
C708 3P
CR706 1S1588
CR705 1S1588
R720 6.8K
R705 100K
C701 1M 35W.V TANTAL
R706 100K
C703 1M 35W.V TANTAL
R707 100K
C705 1M 35W.V TANTAL
AUTO TRIG U505 NO.3
U702
U702
U701
B CLR
R704 680
R701 1K
Q701 2SA844
R702 220
R703 1.5K
CR702 1S1588
CR703 1S1588
CR704 1S1588
R713 2.2K
R714 2.2K
R715 2.2K
C702 10M 50W.V
C704 10M 50W.V
C706 10M 50W.V
U703
R708 10K
U504
R710 470
R709 100
R711 2.2K
R712 2.2K
R730 6.8K
VBB NO.11
B SWEEP GATE TO R1009
U708
B TRIG U604 NO.3
P-49
J-49
A6
A8
R752 10
R754 10
C718 10μ50W.V
FROM U505 NO.1,16
R755 4.7
R756 4.7
C720 0.1μ
C721 10μ50W.V
C722 0.1μ
C723 10μ50W.V
C724 0.1μ
U703 TC40 668P
U704 HD10 131
U705 HD10 102
U706 HD10 116
U707 HD10 131
U709 HD10 102

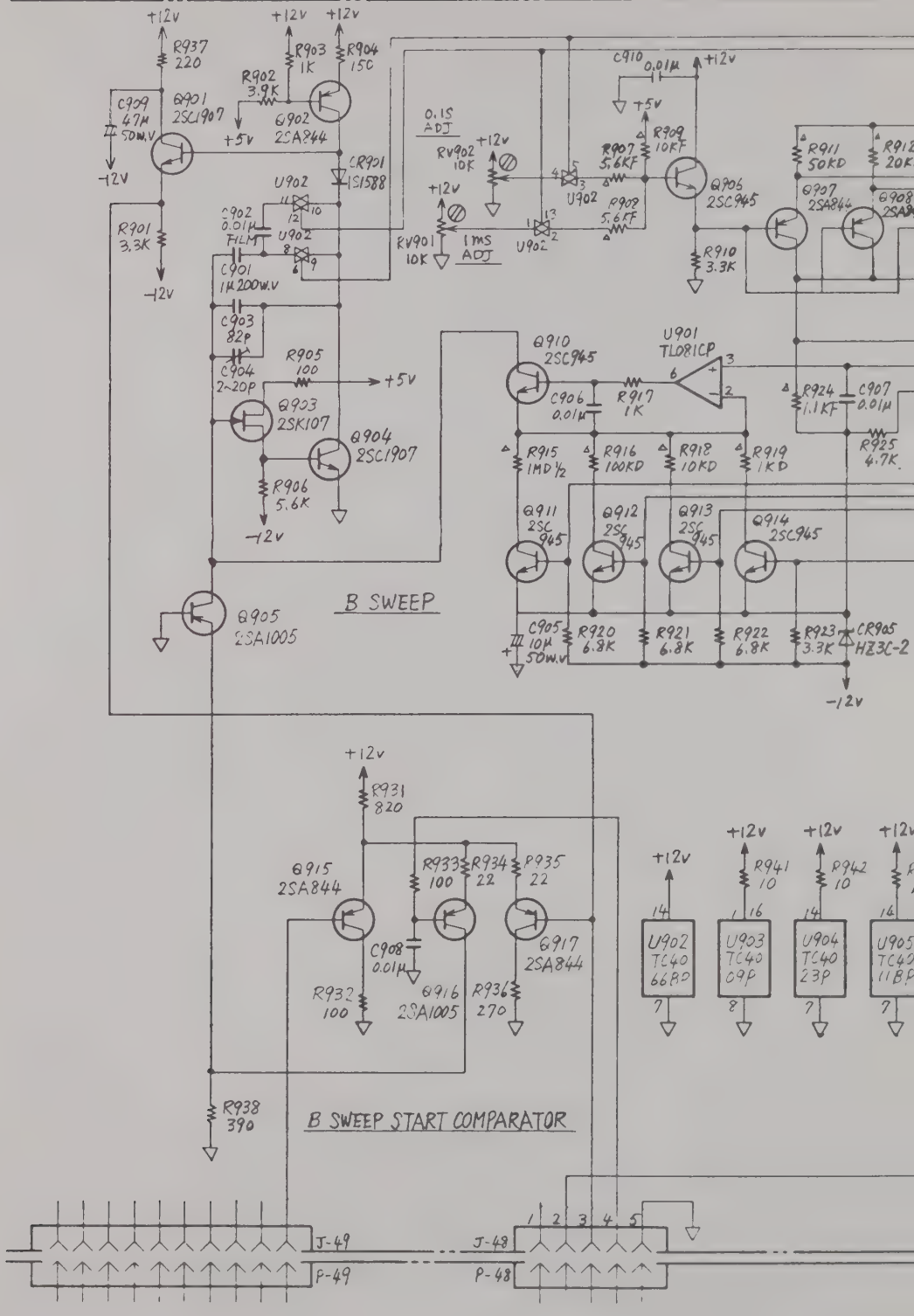


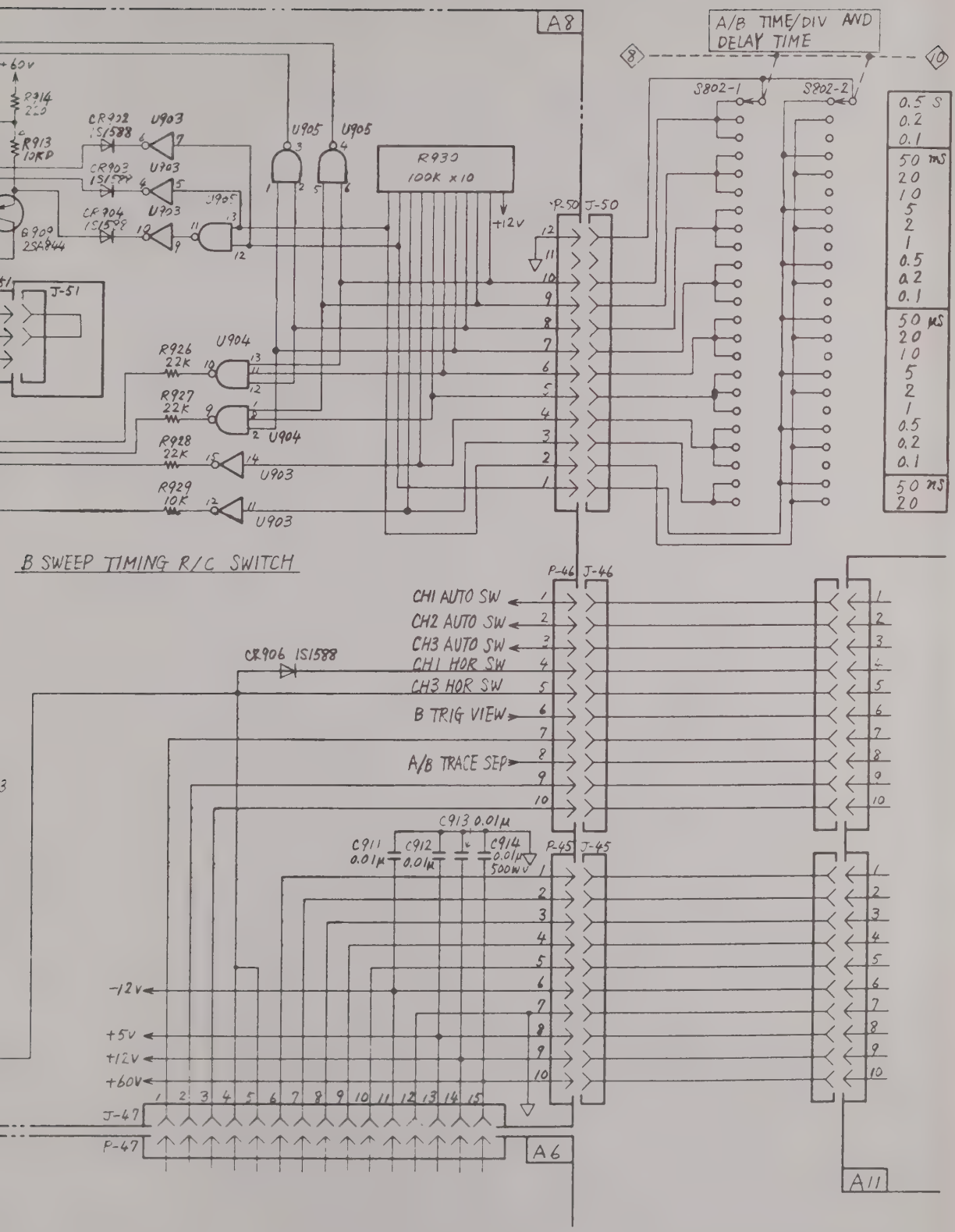
7 A/B SWEEP CONTROL


BEND'S SWEEP GATE
HOLD OUT
SWEEP OUT
START LEVEL
P-62
J-62
P-61
J-61
A SWEEP START COMPARATOR
A SWEEP
J-14
J-64
P-64
A SWEEP GATE
J-13
J-65
P-65
R803 33K
-12V
R802 10K
R801 56
R804 820
+12V
R806 100
Q802 2SA1005
R808 22
Q801 2SA844
C801 0.01μ
Q803 2SA844
R805 100
Q804 2SA1005
R812 1.8K
R813 2.7K
-12V
R809 390
CR801 1S1588
R810 10K
5
HOLD OFF CONT
FROM RV501
R855 220
R819 3.9K
R820 1K
R821 150
Q809 2SA844
+5V
C819 47μ 50W.V
Q808 2SC1907
CR809 1S1588
U802
R818 3.3K
C812 0.01μ FILM
C811 1μ 200W.V
C813 82P
C814 2~20P
R857 82
Q810 2SA1005
R822 100
Q811 2SK107
Q812 2SC1907
R823 5.6K
RV802 10K
0.1S ADJ
RV801 10K
1mS ADJ
R824 5.6KF
R825 5.6KF
R826 10KF
Q813 2SC945
C820 0.01μ
R827 3.3K
Q817 2SC945
U801 TL081CP
C817 0.01μ
R832 1K
R833 1MΩ½
R834 100KΩ
R835 10KΩ
R836 1KΩ
Q818 2SC 945
Q819 2SC 945
Q820 2SC 945
Q821 2SC
C816 10μ 50WV
R839 6.8K
R840 6.8K
R841 6.8K
R851 10
R852 10
R853 10
U802 TC40 66BP
U803 TC40 09P
U804 TC40 23P
U805 TC40 30P
A SWEEP
A SWEEP TIMING R/C SWITCH

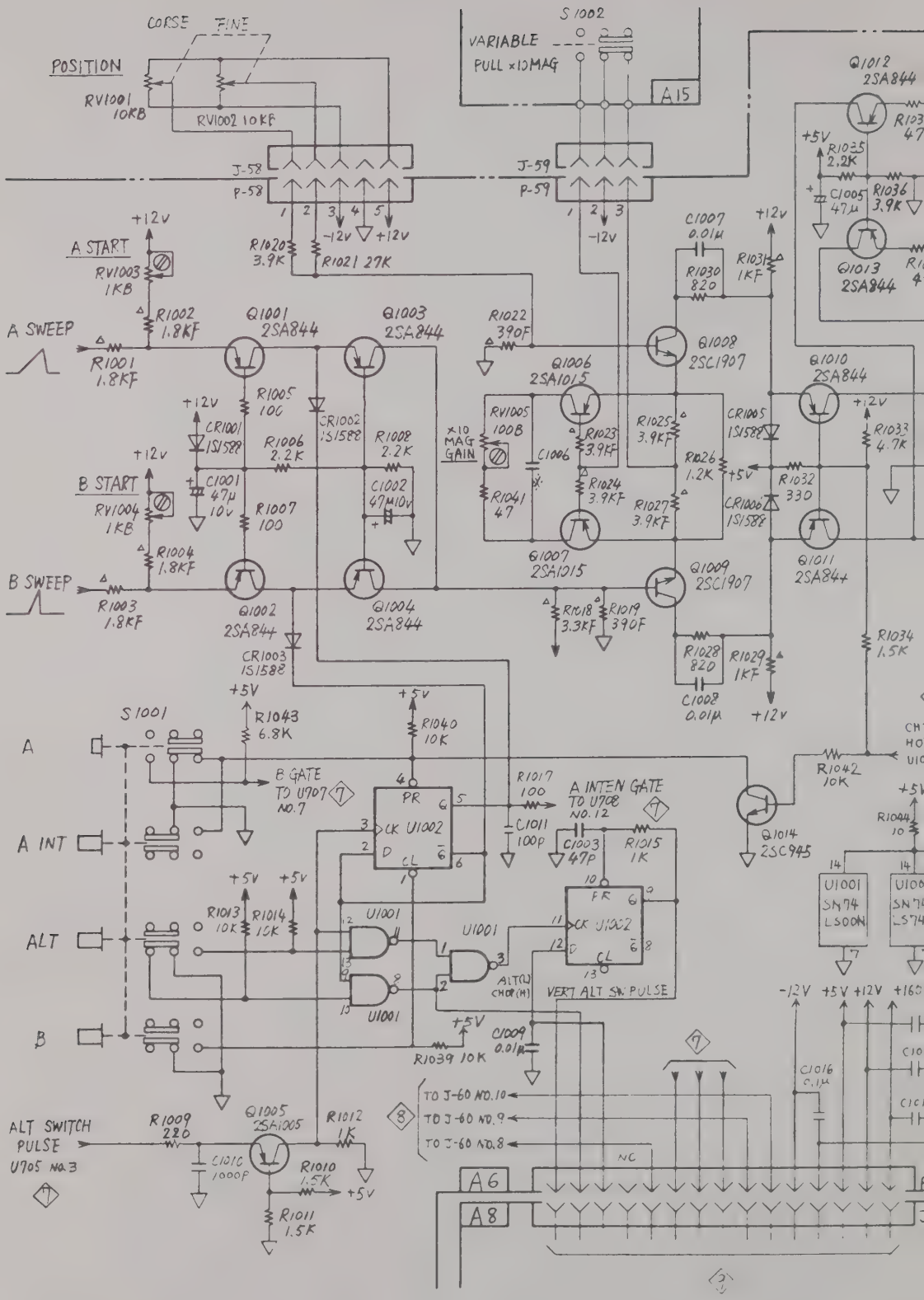


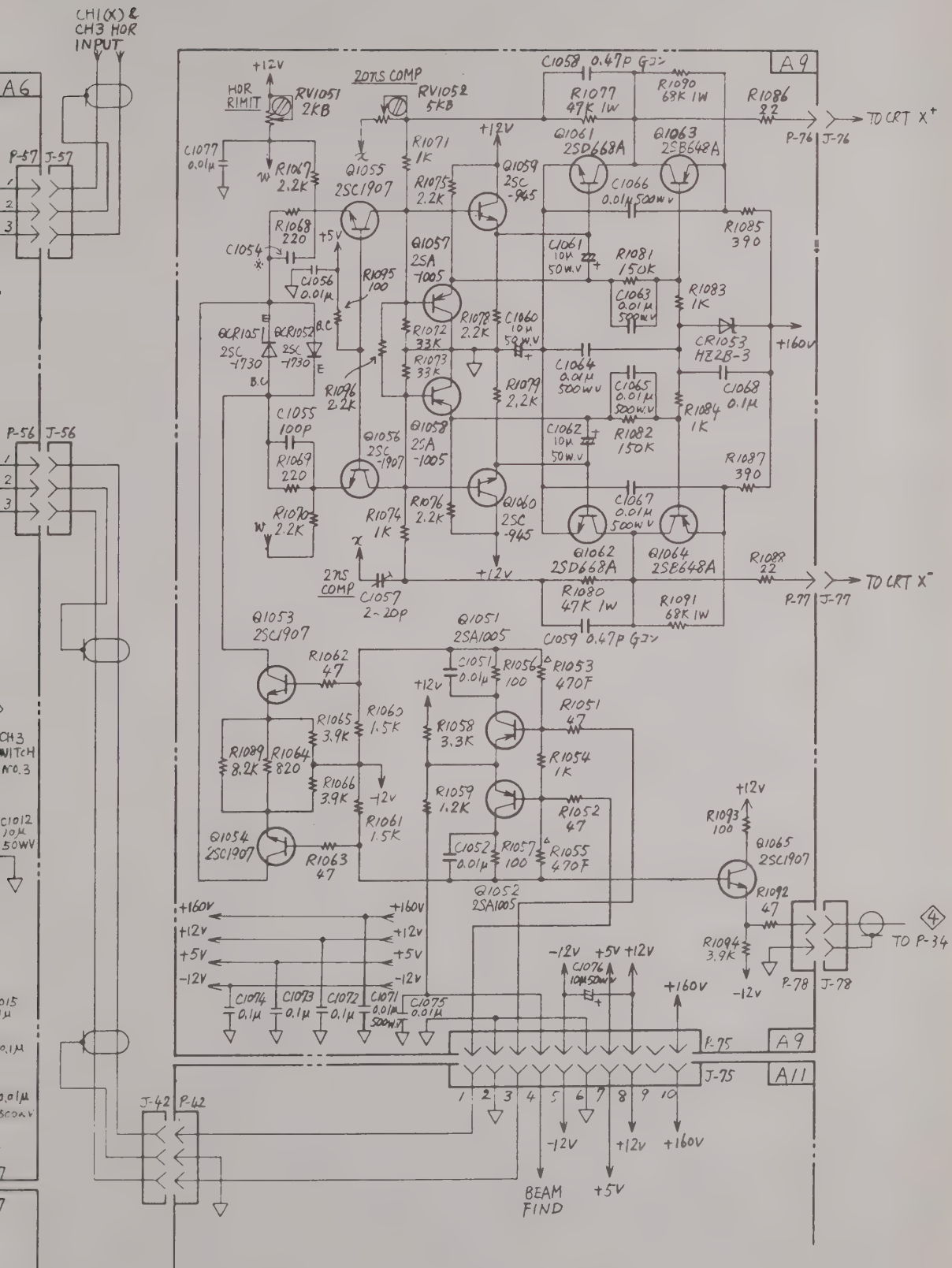
8 A SWEEP GENERATOR


B SWEEP
B SWEEP START COMPARATOR
+12v
-12v
+5v
R937 220
R903 1K
R904 150
R902 3.9K
C909 47M 50W.V
Q901 2SC1907
Q902 2SA844
CR901 1S1588
U902
C902 0.01μ FILM
C901 1M 200W.V
R901 3.3K
C903 82P
C904 2~20P
R905 100
Q903 2SK107
Q904 2SC1907
R906 5.6K
Q905 2SA1005
0.1S ADJ
RV902 10K
RV901 10K
1mS ADJ
C910 0.01μ
R909 10KF
R907 5.6KF
R908 5.6KF
Q906 2SC945
R910 3.3K
R911 50KD
R912 20K
Q907 2SA844
Q908 2SA
U901 TL081CP
Q910 2SC945
C906 0.01μ
R917 1K
R924 1.1KF
C907 0.01μ
R925 4.7K
R915 1MD½
R916 100KD
R918 10KD
R919 1KD
Q911 2SC945
Q912 2SC945
Q913 2SC945
Q914 2SC945
C905 10μ 50W.V
R920 6.8K
R921 6.8K
R922 6.8K
R923 3.3K
CR905 HZ3C-2
R931 820
Q915 2SA844
R933 100
R934 22
R935 22
C908 0.01μ
Q917 2SA844
R932 100
Q916 2SA1005
R936 270
R938 390
R941 10
R942 10
U902 TC40 66B0
U903 TC40 09P
U904 TC40 23P
U905 TC40 11BP
J-49
P-49
J-48
P-48
1 2 3 4 5

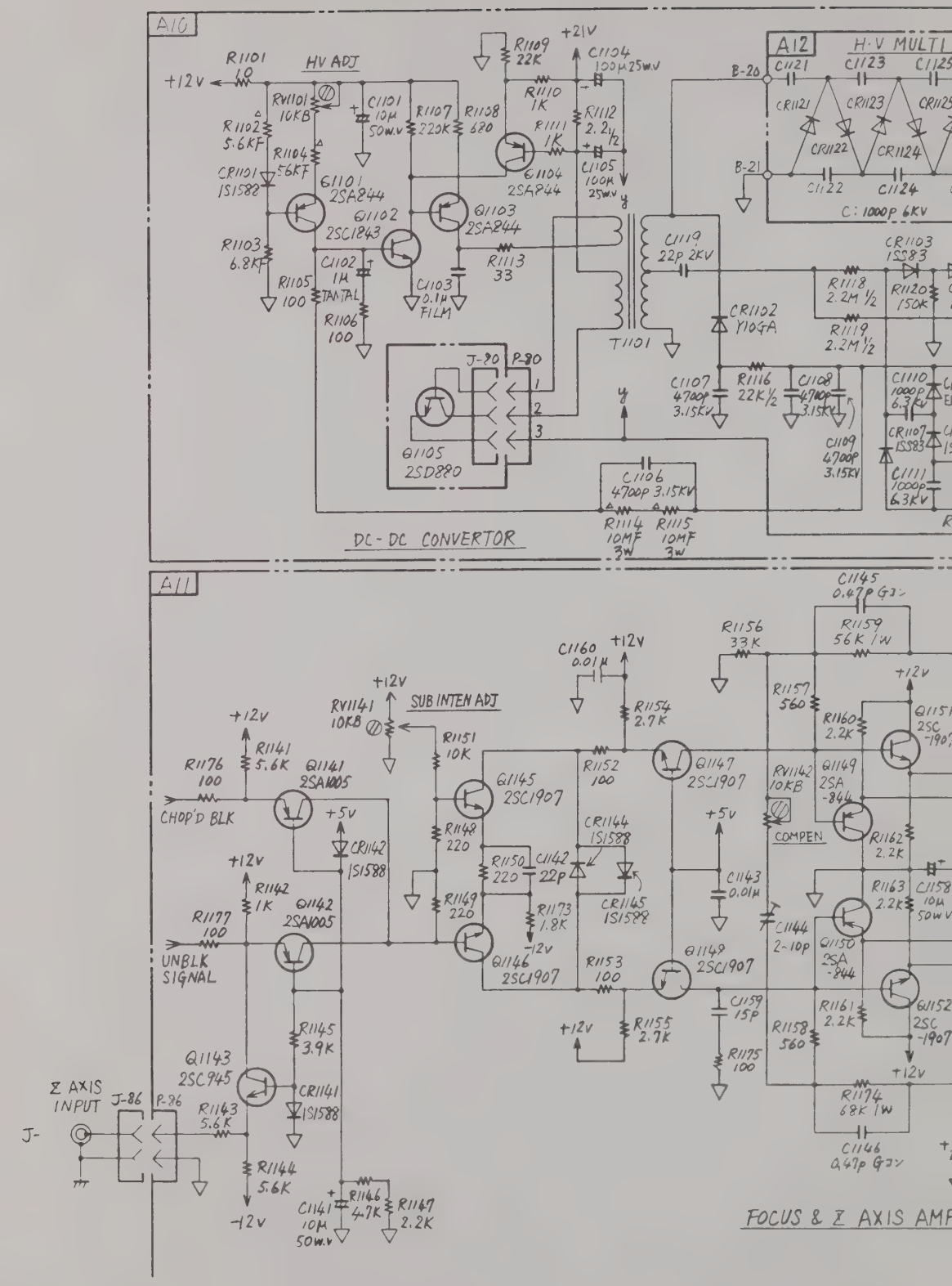


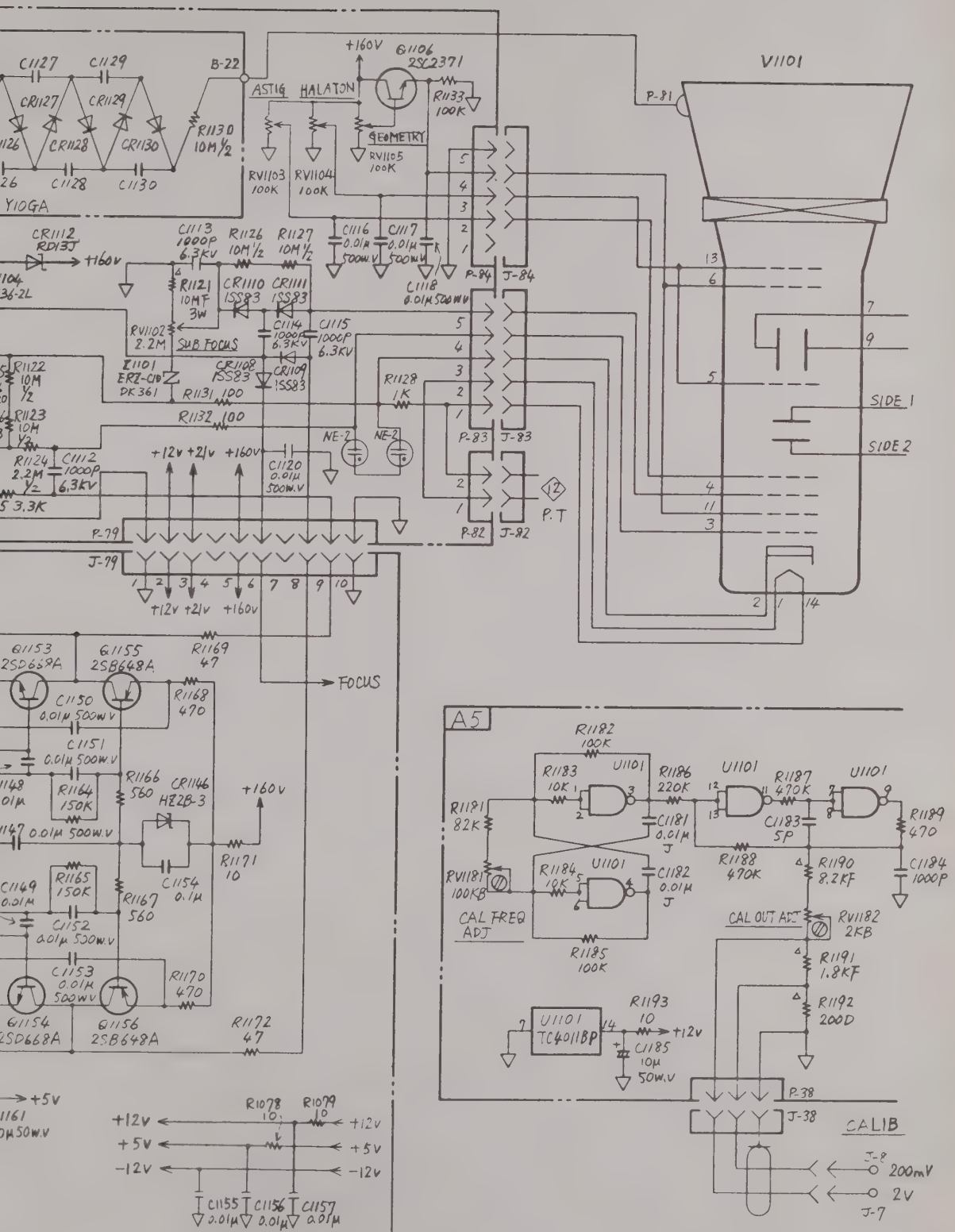
9 B SWEEP GENERATOR

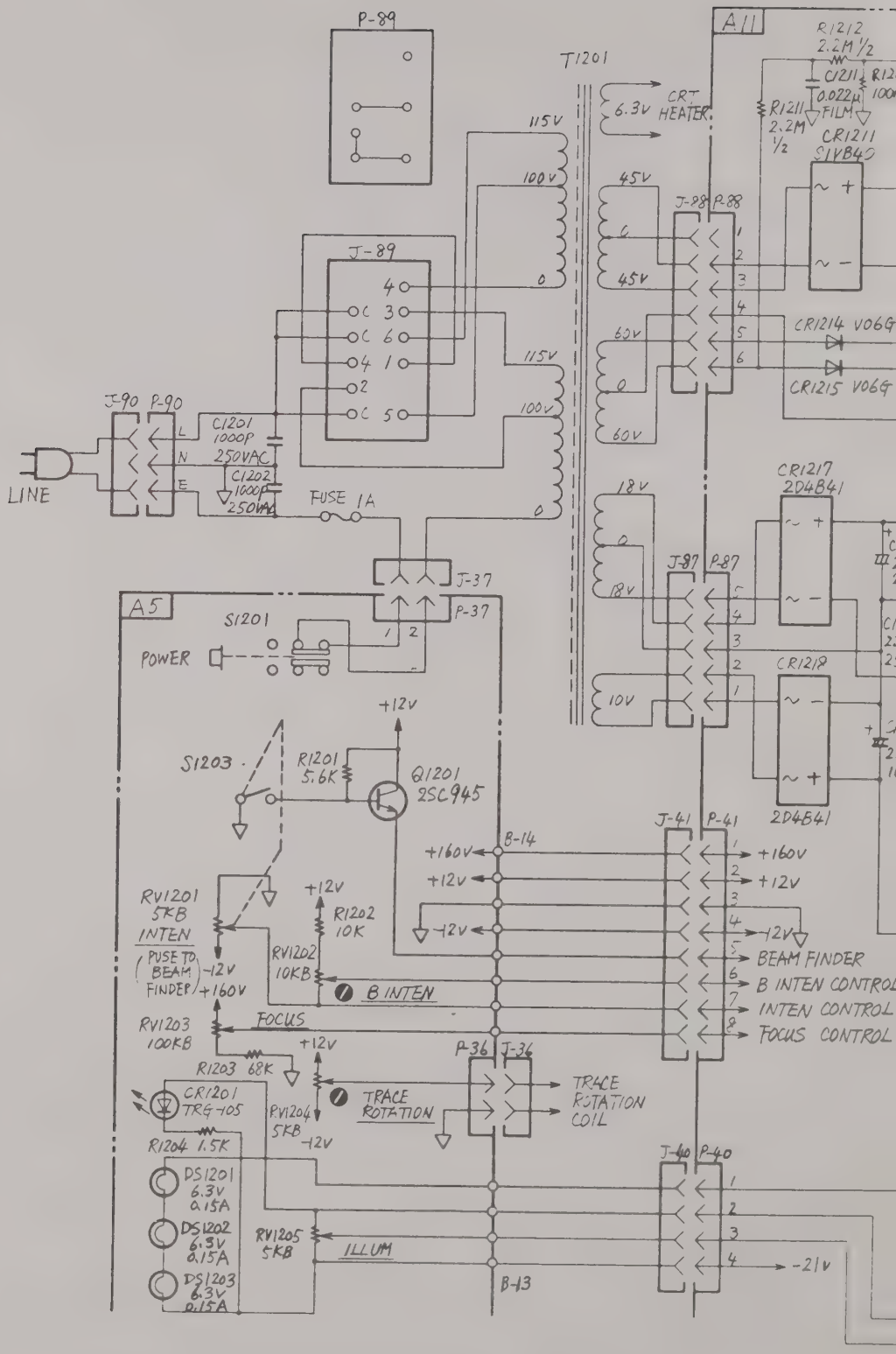

CORSE
FINE
POSITION
RV1001 10KB
RV1002 10KF
S1002
VARIABLE
PULL ×10MAG
A15
J-58
P-58
J-59
P-59
+12V
-12V
A START
RV1003 1KB
R1002 1.8KF
R1020 3.9K
R1021 27K
Q1001 2SA844
Q1003 2SA844
A SWEEP
R1001 1.8KF
R1022 390F
Q1008 2SC1907
Q1006 2SA1015
Q1007 2SA1015
Q1009 2SC1907
Q1010 2SA844
Q1011 2SA844
Q1012 2SA844
Q1013 2SA844
R1035 2.2K
R1036 3.9K
C1005 47μ
C1007 0.01μ
R1030 820
R1031 1KF
R1033 4.7K
R1032 330
R1034 1.5K
R1042 10K
Q1014 2SC945
R1044 10
R1005 100
R1006 2.2K
R1008 2.2K
CR1001 1S1588
CR1002 1S1588
CR1003 1S1588
CR1005 1S1588
CR1006 1S1588
C1001 47μ 10v
C1002 47μ10v
R1007 100
R1004 1.8KF
B START
RV1004 1KB
B SWEEP
R1003 1.8KF
Q1002 2SA844
Q1004 2SA844
RV1005 100B
×10 MAG GAIN
C1006
R1023 3.9KF
R1024 3.9KF
R1025 3.9KF
R1026 1.2K
R1027 3.9KF
R1041 47
R1018 3.3KF
R1019 390F
R1028 820
R1029 1KF
C1008 0.01μ
S1001
A
A INT
ALT
B
R1043 6.8K
R1040 10K
B GATE TO U707 NO.7
R1017 100
C1011 100p
A INTEN GATE TO U708 NO.12
C1003 47p
R1015 1K
U1002
PR
CK
D
CL
U1001
R1013 10K
R1014 10K
ALT/U CHOP(H)
VERT ALT SW. PULSE
R1039 10K
C1009 0.01μ
U1001 SN74 LS00N
-12V +5V +12V +16
C1016 0.1μ
TO J-60 NO.10
TO J-60 NO.9
TO J-60 NO.8
NC
A6
A8
ALT SWITCH PULSE
U705 NO.3
R1009 220
Q1005 2SA1005
R1012 1K
C1010 1000P
R1010 1.5K
R1011 1.5K

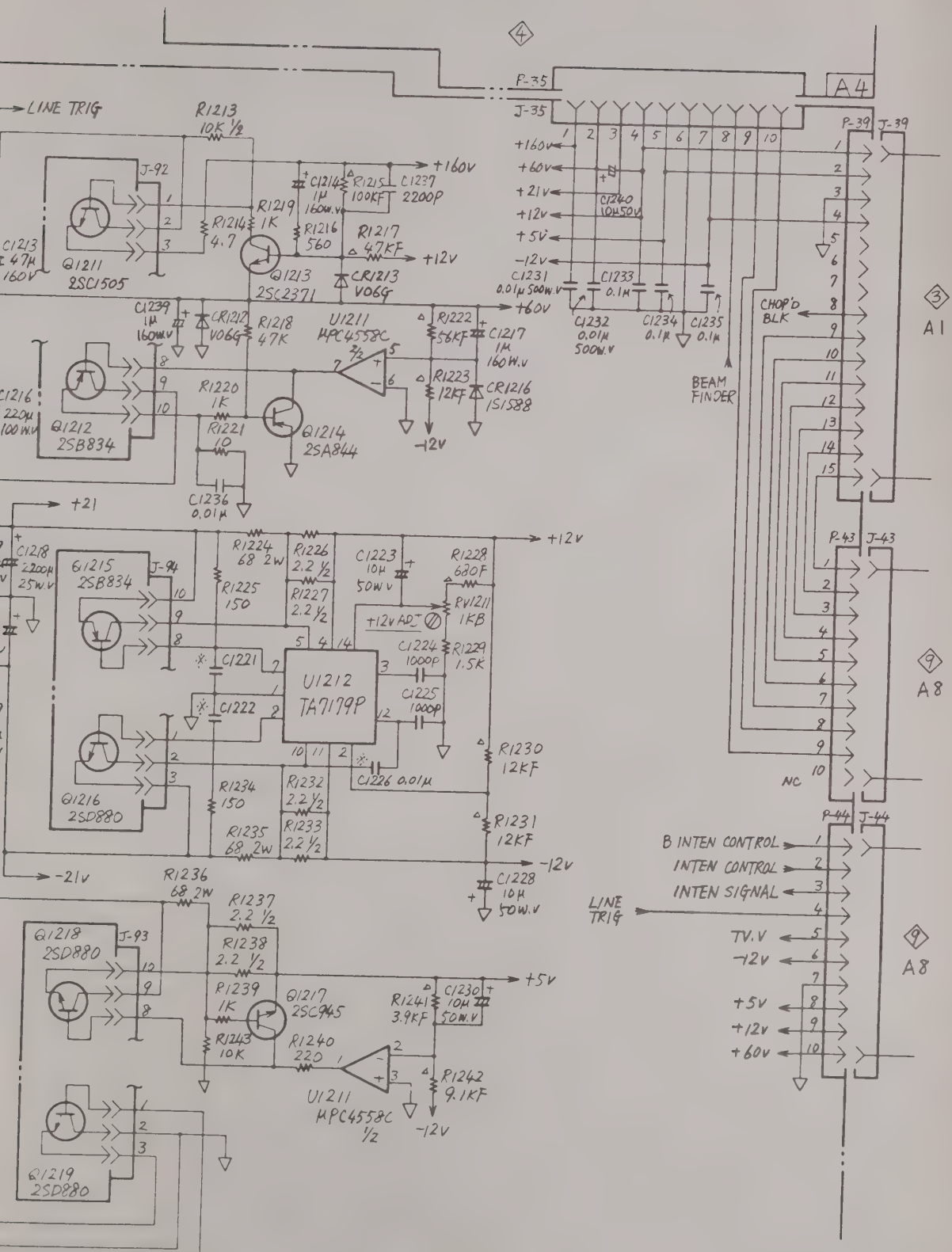


10 HOR SWITCH & OUTPUT AMP


A10
HV ADJ
+12V
R1101 10
RV1101 10KB
R1102 5.6KF
R1104 5.6KF
CR1101 1S1588
Q1101 2SA844
Q1102 2SC1843
Q1103 2SA844
Q1104 2SA844
Q1105 2SD880
R1103 6.8KF
R1105 100
R1106 100
C1101 10μ 50WV
C1102 1μ TANTAL
C1103 0.1μ FILM
R1107 220K
R1108 680
R1109 22K
+21V
C1104 100μ 25WV
R1110 1K
R1111 1K
R1112 2.2½
C1105 100μ 25WV
R1113 33
J-80
P-80
C1106 4700P 3.15KV
R1114 10MF 3W
R1115 10MF 3W
DC-DC CONVERTOR
A12
H·V MULTI
B-26
B-21
C1121
C1123
C1125
CR1121
CR1123
CR1122
CR1124
C1122
C1124
C: 1000P 6KV
C1119 22P 2KV
T1101
CR1102 Y10GA
CR1103 1S583
R1118 2.2M ½
R1120 150K
R1119 2.2M ½
C1107 4700P 3.15KV
R1116 22K ½
C1108 4700P 3.15KV
C1109 4700P 3.15KV
C1110 1000P 6.3KV
CR1107 1S583
C1111 1000P 6.3KV
A11
C1145 0.47P GDV
R1159 56K 1W
R1156 33K
C1160 0.01μ
+12V
RV1141 10KB
SUB INTEN ADJ
R1154 2.7K
R1157 560
R1160 2.2K
R1151 10K
R1152 100
Q1147 2SC1907
RV1142 10KB
COMPEN
Q1149 2SA-844
R1162 2.2K
R1141 5.6K
R1176 100
Q1141 2SA1005
CHOP'D BLK
+5V
CR1142 1S1588
R1148 220
R1150 220
C1142 22P
CR1144 1S1588
CR1145 1S1588
Q1145 2SC1907
R1149 220
R1173 1.8K
Q1146 2SC1907
R1142 1K
R1177 100
Q1142 2SA1005
UNBLK SIGNAL
C1143 0.01μ
C1144 2-10P
R1163 2.2K
C1158 10μ 50WV
Q1150 2SA-844
R1153 100
Q1148 2SC1907
C1159 15P
R1175 100
R1155 2.7K
R1161 2.2K
R1158 560
Q1152 2SC-1907
R1174 68K 1W
C1146 0.47P GDV
Q1143 2SC945
R1145 3.9K
CR1141 1S1588
R1143 5.6K
R1144 5.6K
-12V
C1141 10μ 50WV
R1146 4.7K
R1147 2.2K
Z AXIS INPUT
J-86
P-86
J-
FOCUS & Z AXIS AMP


C1127
C1129
B-22
CR1127
CR1129
CR1128
CR1130
R1130
10M½
C1128
C1130
YIOGA
+160V
Q1106
2SC2371
R1133
100K
ASTIG
HALATON
GEOMETRY
RV1105
100K
RV1103
100K
RV1104
100K
V1101
P-81
CR1112
RD13J
+160v
C1113
1000P
6.3KV
R1126
10M½
R1127
10M½
C1116
0.01μ
500W.V
C1117
0.01μ
500W.V
C1118
0.01μ 500W.V
P-84
J-84
R1121
10MF
3W
CR1110
1SS83
CR1111
1SS83
RV1102
2.2M
SUB FOCUS
C1114
1000P
6.3KV
C1115
1000P
6.3KV
Z1101
ERZ-C10
DK361
CR1108
1SS83
CR1109
1SS83
R1131 100
R1132 100
R1128
1K
P-83
J-83
R1122
10M
½
R1123
10M
½
R1124
2.2M
½
C1112
1000P
6.3KV
NE-2
NE-2
+12v +21v +160v
C1120
0.01μ
500W.V
P-82
J-82
P.T
SIDE 1
SIDE 2
P-79
J-79
+12v +21v +160v
Q1153
2SD668A
Q1155
2SB648A
R1169
47
FOCUS
C1150
0.01μ 500W.V
R1168
470
C1151
0.01μ 500W.V
R1166
560
CR1146
HZ2B-3
+160v
R1164
150K
0.01μ 500W.V
R1171
10
C1154
0.1μ
R1165
150K
R1167
560
C1152
0.01μ 500W.V
C1153
0.01μ
500W.V
R1170
470
Q1154
2SD668A
Q1156
2SB648A
R1172
47
+5v
R1078
10
R1079
10
+12v
+5v
-12v
C1155
0.01μ
C1156
0.01μ
C1157
0.01μ
A5
R1182
100K
R1183
10K
U1101
R1186
220K
U1101
R1187
470K
U1101
R1181
82K
C1181
0.01μ
J
C1183
5P
R1189
470
R1188
470K
R1190
8.2KF
C1184
1000P
RV1181
100KB
R1184
10K
U1101
C1182
0.01μ
J
CAL FREQ
ADJ
CAL OUT ADJ
RV1182
2KB
R1185
100K
R1191
1.8KF
R1192
200D
U1101
TC4011BP
R1193
10
+12v
C1185
10μ
50W.V
P-38
J-38
CALIB
J-8
200mV
2V
J-7


P-89
T1201
A11
R1212
2.2M 1/2
C1211
0.022μ FILM
CR1211
SIVB40
R1211
2.2M
1/2
6.3V
CRT
HEATER
115V
100V
0
45V
J-88
P-88
45V
60V
0
60V
CR1214 V06G
CR1215 V06G
J-89
4
3
6
1
2
5
115V
100V
0
J-90
P-90
L
N
E
LINE
C1201
1000P
250VAC
C1202
1000P
250VAC
FUSE 1A
J-37
P-37
A5
S1201
POWER
1
2
18V
0
18V
J-87
P-87
CR1217
2D4B41
CR1218
10V
2D4B41
+12V
S1203
R1201
5.6K
Q1201
2SC945
J-41
P-41
B-14
+160V
+12V
-12V
+160V
+12V
-12V
BEAM FINDER
B INTEN CONTROL
INTEN CONTROL
FOCUS CONTROL
RV1201
5KB
INTEN
(PUSE TO BEAM FINDER)
-12V
+160V
+12V
R1202
10K
RV1202
10KB
B INTEN
RV1203
100KB
FOCUS
+12V
R1203 68K
P-36
J-36
TRACE
ROTATION
COIL
CR1201
TRG-105
RV1204
5KB
TRACE
ROTATION
-12V
R1204 1.5K
J-40
P-40
DS1201
6.3V
0.15A
DS1202
6.3V
0.15A
DS1203
6.3V
0.15A
RV1205
5KB
ILLUM
B-13
-21V


LINE TRIG
R1213 10K 1/2
J-92
Q1211 2SC1505
C1213 47μ 160V
R1214 4.7
R1219 1K
R1216 560
C1214 1μ 160W.V
R1215 100KF
C1237 2200P
+160V
R1217 47KF
+12V
Q1213 2SC2371
CR1213 V06G
C1239 1μ 160W.V
CR1212 V06G
R1218 47K
U1211 μPC4558C 2/2
R1222 56KF
C1217 1μ 160W.V
R1223 12KF
CR1216 1S1588
-12V
C1216 220μ 100W.V
Q1212 2SB834
R1220 1K
R1221 10
Q1214 2SA844
C1236 0.01μ
+21
C1218 2200μ 25W.V
Q1215 2SB834
J-94
R1224 68 2W
R1226 2.2 1/2
R1225 150
R1227 2.2 1/2
C1223 10μ 50W.V
R1228 680F
RV1211 1KB
+12V ADJ
C1224 1000P
R1229 1.5K
C1221
C1222
U1212 TA7179P
C1225 1000P
C1226 0.01μ
R1230 12KF
Q1216 2SD880
R1234 150
R1232 2.2 1/2
R1233 2.2 1/2
R1235 68 2W
R1231 12KF
-12V
C1228 10μ 50W.V
-21V
R1236 68 2W
R1237 2.2 1/2
Q1218 2SD880
J-93
R1238 2.2 1/2
+5V
R1239 1K
Q1217 2SC945
R1241 3.9KF
C1230 10μ 50W.V
R1243 10K
R1240 220
U1211 μPC4558C 1/2
R1242 9.1KF
-12V
Q1219 2SD880
P-35
J-35
A4
+160V
+60V
+21V
+12V
+5V
-12V
C1240 10μ 50V
C1231 0.01μ 500W.V
C1232 0.01μ 500W.V
C1233 0.1μ
C1234 0.1μ
C1235 0.1μ
BEAM FINDER
P-39
J-39
CHOP'D BLK
3
A1
P-43
J-43
9
A8
NC
P-44
J-44
B INTEN CONTROL
INTEN CONTROL
INTEN SIGNAL
LINE TRIG
TV.V
-12V
+5V
+12V
+60V
9
A8

REPLACEABLE PARTS

ABBREVIATION

CER:	CERAMIC
C FILM:	CARBON FILM
C COMP:	CARBON COMPOSITION
CRT:	CATHODE RAY TUBE
ELECT:	ELECTROLYTIC
FET:	FIELD EFFECT TRANSISTOR
FXD:	FIXED
LED:	LIGHT EMITTING DIODE
M FILM:	METAL FILM
M GLAZE:	METAL GLAZE
M OX:	METAL OXIDE
M PLSTC FILM:	METALLIZED PLASTIC FILM
PLSTC FILM:	PLASTIC FILM
SI:	SILICON
TANT ELECT:	TANTALUM ELECTROLYTIC
VAR:	VARIABLE
WW:	WIREWOUND
*:	OPTIMUM VALUE SELECTED AT FACTORY. AVERAGE VALUE SHOWN (PART MAY BE OMITTED.)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
A1	ASSEMBLY		
A1	90-50-2690	PCB A1 VERT PREAMP &SWICH	
CR101	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR102	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR103	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR104	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR105	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR201	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR202	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR203	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR204	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR205	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR301	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR302	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR303	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR304	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR351	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR352	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR353	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR354	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR355	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR356	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR357	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR358	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR359	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR360	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR361	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR362	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR401	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR402	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR403	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR404	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR405	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR406	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR407	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR408	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR409	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
Q101	31-20-0580	FET DUAL	SONY 2SK58
Q102	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q103	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q104	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q105	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q106	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q107	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q108	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q109	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q110	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q111	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q112	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q113	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q114	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q201	31-20-0580	FET DUAL	SONY 2SK58
Q202	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q203	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q204	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q205	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q209	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q210	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q211	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q212	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q213	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q214	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q308	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q309	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q310	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q311	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q351	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q352	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q353	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q354	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q355	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q401	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q402	30-10-7111	TR SILICON PNP	NEC 2SA711
Q403	30-10-7111	TR SILICON PNP	NEC 2SA711
Q404	30-31-9071	TR SILICON NPN	HITACHI 2SC1907

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
Q405		30-32-5700	TR SILICON NPN	NEC 2SC2570
Q406		30-32-5700	TR SILICON NPN	NEC 2SC2570
Q407		30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q408		30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q409		30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q410		30-11-0051	TR SILICON PNP	NEC 2SA1005-L
QCR101		30-31-9071	TR SILICON NPN	HITACHI 2SC1907
QCR201		30-31-9071	TR SILICON NPN	HITACHI 2SC1907
U101		30-90-0150	TRANSISTOR ARRAYS 5 NPN	
U201		30-90-0150	TRANSISTOR ARRAYS 5 NPN	
U301		35-70-1581	QUARD 2-TO-1 DATA SELECTOR(-)	
U302		35-70-0081	QUAD 2-INPUT POSI-AND	
U303		35-70-0041	HEX INVERTERS	
U304		35-70-0081	QUAD 2-INPUT POSI-AND	
U305		35-70-0421	BCD TO DECIMAL DECORDERS	
R101		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R102		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R103		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R104		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R105		42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W	
R106		42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W	
R107		40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
R108		42-73-4990	FXD M FILM 990K OHM 0.5% 1/2W	
R109		42-71-3101	FXD M FILM 10.1K OHM 0.5% 1/4W	
R110		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R111		40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
R112		40-27-0682	FXD C FILM 68 OHM 5% 1/4W	
R113		42-73-4500	FXD M FILM 500K OHM 0.5% 1/2W	
R114		42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R115		42-73-4800	FXD M FILM 800K OHM 0.5% 1/2W	
R116		42-71-4250	FXD M FILM 250K OHM 0.5% 1/4W 100PPM/DEG	
R117		42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R118		40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R119		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R120		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R121		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R122		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R123		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R124		42-72-3470	FXD M FILM 47K OHM 1% 1/4W	
R125		42-72-1330	FXD M FILM 330 OHM 1% 1/4W	
R126		38-00-0000	THERMISTER 250 OHM	
R127	*	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	
R128		40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R129		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R130		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R131		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R132		40-27-1272	FXD C FILM 270 OHM 5% 1/4W	
R133		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R134		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R135		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R136		42-72-0820	FXD M FILM 82 OHM 1% 1/4W	
R137		42-72-0820	FXD M FILM 82 OHM 1% 1/4W	
R138	*	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R139		42-72-1120	FXD M FILM 120 OHM 1% 1/4W	
R140		40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R141		40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R142		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R143		40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R145		42-72-1560	FXD M FILM 560 OHM 1% 1/4W	
R146		40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R147		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R148		42-72-1560	FXD M FILM 560 OHM 1% 1/4W	
R149		42-72-0330	FXD M FILM 33 OHM 1% 1/4W	
R150		42-72-0330	FXD M FILM 33 OHM 1% 1/4W	
R151		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R152		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R153		42-72-1180	FXD M FILM 180 OHM 1% 1/4W	
R154		42-72-1180	FXD M FILM 180 OHM 1% 1/4W	
R155		40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R156		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R157		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
R158		42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W	
R159		42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W	
R160	*	42-72-2270	FXD M FILM 2.7K OHM 1% 1/4W	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R161		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R162		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R163		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R164		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R165		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R166		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R167		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R168		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R169		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R170		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R171		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R172		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R173		38-00-0000	THERMISTER 250 OHM
R174		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R177		40-27-0562	FXD C FILM 56 OHM 5% 1/4W
R181		40-27-0562	FXD C FILM 56 OHM 5% 1/4W
R182		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R184		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R185		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R186		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R187		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R188		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R189		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R190		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R191		42-72-1560	FXD M FILM 560 OHM 1% 1/4W
R192		42-72-1560	FXD M FILM 560 OHM 1% 1/4W
R193		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R194		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R195		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R196		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R197		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R198		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R199		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R201		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R202		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R203		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R204		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R205		42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W
R206		42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W
R207		40-27-0562	FXD C FILM 56 OHM 5% 1/4W
R208		42-73-4990	FXD M FILM 990K OHM 0.5% 1/2W
R209		42-71-3101	FXD M FILM 10.1K OHM 0.5% 1/4W
R210		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R211		40-27-0562	FXD C FILM 56 OHM 5% 1/4W
R212		40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R213		42-73-4500	FXD M FILM 500K OHM 0.5% 1/2W
R214		42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG
R215		42-73-4800	FXD M FILM 800K OHM 0.5% 1/2W
R216		42-71-4250	FXD M FILM 250K OHM 0.5% 1/4W 100PPM/DEG
R217		42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG
R218		40-37-4471	FXD C FILM 470K OHM 5% 1/2W
R219		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R220		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R221		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R222		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R223		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R224		42-72-3470	FXD M FILM 47K OHM 1% 1/4W
R225		42-72-1330	FXD M FILM 330 OHM 1% 1/4W
R226		38-00-0000	THERMISTER 250 OHM
R227	*	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R228		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R229		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R230		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R231		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R232		40-27-1272	FXD C FILM 270 OHM 5% 1/4W
R233		40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R234		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R235		40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W
R236		42-72-0820	FXD M FILM 82 OHM 1% 1/4W
R237		42-72-0820	FXD M FILM 82 OHM 1% 1/4W
R238	*	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R239		42-72-1120	FXD M FILM 120 OHM 1% 1/4W
R240		40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R241		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R242		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R243		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R245		42-72-1560	FXD M FILM 560 OHM 1% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R246		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R247		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R248		42-72-1560	FXD M FILM 560 OHM 1% 1/4W
R249		42-72-0330	FXD M FILM 33 OHM 1% 1/4W
R250		42-72-0330	FXD M FILM 33 OHM 1% 1/4W
R251		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R252		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R253		42-72-1180	FXD M FILM 180 OHM 1% 1/4W
R254		42-72-1180	FXD M FILM 180 OHM 1% 1/4W
R255		40-27-3472	FXD C FILM 47K OHM 5% 1/4W
R256		40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R257		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R258		42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W
R259		42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W
R260	*	42-72-2270	FXD M FILM 2.7K OHM 1% 1/4W
R261		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R262		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R265		40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R266		40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R267		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R268		40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R269		40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R270		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R271		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R272		40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R273		38-00-0000	THERMISTER 250 OHM
R274		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R281		40-27-0562	FXD C FILM 56 OHM 5% 1/4W
R282		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R284		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R285		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R286		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R287		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R288		40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R289		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R290		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R291		42-72-1560	FXD M FILM 560 OHM 1% 1/4W
R292		42-72-1560	FXD M FILM 560 OHM 1% 1/4W
R293		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R294		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R295		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R296		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R297		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R298		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R299		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R331		40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R332		40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R333		40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R334		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R335		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R336		42-72-1619	FXD M FILM 619 OHM 1% 1/4W
R337		42-72-1619	FXD M FILM 619 OHM 1% 1/4W
R338		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R339		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R340		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R341		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R342		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R343		40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R344		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R345		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R346		40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R347		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R348		40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R351		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R352		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R353		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R354		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R355		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R356		40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R357		42-72-1390	FXD M FILM 390 OHM 1% 1/4W
R358		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R359		42-72-1390	FXD M FILM 390 OHM 1% 1/4W
R360		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R361		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R362		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R363		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R364		40-27-0472	FXD C FILM 47 OHM 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R365	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R367	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R368	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R369	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R370	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R371	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R372	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R373	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R374	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R375	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R376	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R377	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R378	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R379	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R380	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R381	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R382	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R383	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R384	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R385	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R386	44-07-0020	FXD M GLASE RESISTOR NETWORKS 10K OHM X4
R387	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R388	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R389	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R390	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R401	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R402	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R403	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R404	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R405	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R406	42-72-1270	FXD M FILM 270 OHM 1% 1/4W
R407	40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R408	42-72-1270	FXD M FILM 270 OHM 1% 1/4W
R409	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R410	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R411	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R412	40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R413	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R414	40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R415	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R416	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R417	40-27-0562	FXD C FILM 56 OHM 5% 1/4W
R418	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R419	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R420	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R421	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R422	42-72-1220	FXD M FILM 220 OHM 1% 1/4W
R423	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R424	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R425	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R426	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R427	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R428	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R429	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R430	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R431	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R432	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R433	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R434	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R435	40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R436	40-27-0682	FXD C FILM 68 OHM 5% 1/4W
R437	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R2171	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R2172	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R2173	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R2174	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R2175	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R2176	42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R2178	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R2179	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R2180	40-27-0562	FXD C FILM 56 OHM 5% 1/4W
RV101	48-26-3220	VAR M GLAZE 22K OHM
RV102	48-26-3220	VAR M GLAZE 22K OHM
RV103	45-01-0540	VAR C COMP 500 OHM B
RV104	48-26-3220	VAR M GLAZE 22K OHM
RV106	48-26-2100	VAR M GLAZE 1K OHM

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
RV107		48-26-2100	VAR M GLAZE 1K OHM
RV109		48-26-2100	VAR M GLAZE 1K OHM
RV110		48-26-2100	VAR M GLAZE 1K OHM
RV201		48-26-3220	VAR M GLAZE 22K OHM
RV202		48-26-3220	VAR M GLAZE 22K OHM
RV203		45-01-0540	VAR C COMP 500 OHM B
RV204		48-26-3220	VAR M GLAZE 22K OHM
RV206		48-26-2100	VAR M GLAZE 1K OHM
RV207		48-26-2100	VAR M GLAZE 1K OHM
RV209		48-26-2100	VAR M GLAZE 1K OHM
RV306		48-26-2100	VAR M GLAZE 1K OHM
RV307		48-26-2100	VAR M GLAZE 1K OHM
RV401		48-26-1100	VAR M GLAZE 100 OHM
RV402		48-26-2100	VAR M GLAZE 1K OHM
RV403		46-20-3101	VAR M GLAZE 10K OHM B
RV404		46-20-3101	VAR M GLAZE 10K OHM B
C101		50-96-3590	FXD PLSTC FILM 0.022MF 20% 630V
C102		52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C103		52-06-2245	FXD CER 150PF 10% 50V TYPE 1
C104		57-10-1180	VAR CER 1.5-4PF
C105		57-10-1190	VAR CER 3-10PF
C106		52-06-3102	FXD CER 10PF 10% 500V TYPE 1
C107		57-10-1180	VAR CER 1.5-4PF
C108		57-10-1190	VAR CER 3-10PF
C109		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C110		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C111		52-06-2215	FXD CER 82PF 10% 500V TYPE 1
C112		57-10-1180	VAR CER 1.5-4PF
C113		57-10-1180	VAR CER 1.5-4PF
C114		57-10-1180	VAR CER 1.5-4PF
C115		57-10-1180	VAR CER 1.5-4PF
C116		52-06-3030	FXD CER 3PF 500V TYPE 1
C117		50-87-0510	FXD PLSTC FILM 2200 20% 400V
C118		52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C119		52-01-3345	FXD CER 1000PF 10% 500V
C120		52-01-3345	FXD CER 1000PF 10% 500V
C121	*	52-06-3030	FXD CER 3PF 500V TYPE 1
C122		52-01-3345	FXD CER 1000PF 10% 500V
C123		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C124		55-37-2050	FXD TANT ELECT 1MF 35V
C125		50-67-0050	FXD PLSTC FILM 0.047MF 10% 100V
C126		57-10-1180	VAR CER 1.5-4PF
C127		57-10-1180	VAR CER 1.5-4PF
C128		52-06-3145	VAR CER 1.5-4PF
C129		52-05-2468	FXD CER 0.01MF 50V
C130		52-05-2468	FXD CER 0.01MF 50V
C131		52-05-2468	FXD CER 0.01MF 50V
C132		52-06-3145	VAR CER 1.5-4PF
C133		52-06-3145	VAR CER 1.5-4PF
C134		52-06-3010	FXD CER 1PF 500V TYPE 1
C136		54-00-0114	FXD ELECTROLYTIC 47MF 25V
C137		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C138		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C139		52-06-3030	FXD CER 3PF 500V TYPE 1
C139		52-06-3030	FXD CER 3PF 500V TYPE 1
C140		52-06-3165	FXD CER 33PF 10% 500V TYPE 1
C141		57-10-1190	VAR CER 3-10PF
C142		57-10-1190	VAR CER 3-10PF
C143	*	52-06-2265	FXD CER 220PF 10% 50V TYPE 1
C144		52-05-2468	FXD CER 0.01MF 50V
C145		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C146	*	52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C147		52-01-3345	FXD CER 1000PF 10% 500V
C148		52-01-3345	FXD CER 1000PF 10% 500V
C149		52-01-3345	FXD CER 1000PF 10% 500V
C150		52-01-3345	FXD CER 1000PF 10% 500V
C151		52-05-2468	FXD CER 0.01MF 50V
C152		52-05-2468	FXD CER 0.01MF 50V
C153		52-05-2468	FXD CER 0.01MF 50V
C154		52-06-3030	FXD CER 3PF 500V TYPE 1
C155		52-06-3030	FXD CER 3PF 500V TYPE 1
C201		50-96-3590	FXD PLSTC FILM 0.022MF 20% 630V
C202		52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C203		52-06-2245	FXD CER 150PF 10% 50V TYPE 1
C204		57-10-1180	VAR CER 1.5-4PF
C205		57-10-1190	VAR CER 3-10PF

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
C206		52-06-3102	FXD CER 10PF 10% 500V TYPE 1
C207		57-10-1180	VAR CER 1.5-4PF
C208		57-10-1190	VAR CER 3-10PF
C209		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C210		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C211		52-06-2215	FXD CER 82PF 10% 500V TYPE 1
C212		57-10-1180	VAR CER 1.5-4PF
C213		57-10-1180	VAR CER 1.5-4PF
C214		57-10-1180	VAR CER 1.5-4PF
C215		57-10-1180	VAR CER 1.5-4PF
C216		52-06-3030	FXD CER 3PF 500V TYPE 1
C217		50-87-6510	FXD PLSTC FILM 2200 20% 400V
C218		52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C219		52-01-3345	FXD CER 1000PF 10% 500V
C220		52-01-3345	FXD CER 1000PF 10% 500V
C221	*	52-06-3030	FXD CER 3PF 500V TYPE 1
C222		52-01-3345	FXD CER 1000PF 10% 500V
C223		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C224		55-37-2050	FXD TANT ELECT 1MF 35V
C225		50-87-6050	FXD PLSTC FILM 0.047MF 10% 100V
C226		57-10-1180	VAR CER 1.5-4PF
C227		57-10-1180	VAR CER 1.5-4PF
C228		52-06-3145	VAR CER 1.5-4PF
C229		52-05-2468	FXD CER 0.01MF 50V
C230		52-05-2468	FXD CER 0.01MF 50V
C231		52-05-2468	FXD CER 0.01MF 50V
C232		52-06-3147	VAR CER 1.5-4PF
C233		52-06-3145	VAR CER 1.5-4PF
C234		52-06-3010	FXD CER 1PF 500V TYPE 1
C236		54-00-0114	FXD ELECTROLYTIC 47MF 25V
C237		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C238		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C241		57-10-1190	VAR CER 3-10PF
C242		57-10-1190	VAR CER 3-10PF
C246	*	52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C247		52-01-3345	FXD CER 1000PF 10% 500V
C248		52-01-3345	FXD CER 1000PF 10% 500V
C249		52-01-3345	FXD CER 1000PF 10% 500V
C250		52-01-3345	FXD CER 1000PF 10% 500V
C251		52-05-2468	FXD CER 0.01MF 50V
C252		52-06-3145	VAR CER 1.5-4PF
C253		52-05-2468	FXD CER 0.01MF 50V
C331		52-06-3185	FXD CER 47PF 10% 500V TYPE 1
C332		52-06-2245	FXD CER 150PF 10% 50V TYPE 1
C333		52-01-3345	FXD CER 1000PF 10% 500V
C351		52-05-2468	FXD CER 0.01MF 50V
C352		52-05-2468	FXD CER 0.01MF 50V
C353	*	52-06-3125	FXD CER 15PF 10% 500V TYPE 1
C355		52-05-2468	FXD CER 0.01MF 50V
C356		52-05-2468	FXD CER 0.01MF 50V
C357		52-05-2468	FXD CER 0.01MF 50V
C358		52-05-2468	FXD CER 0.01MF 50V
C359		52-05-2468	FXD CER 0.01MF 50V
C361		52-05-2468	FXD CER 0.01MF 50V
C362		52-05-2468	FXD CER 0.01MF 50V
C363		52-05-2468	FXD CER 0.01MF 50V
C364		52-05-2468	FXD CER 0.01MF 50V
C365		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C366		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C367		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C368		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C369		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C370		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C371		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C372		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C373		52-06-3030	FXD CER 3PF 500V TYPE 1
C374		52-06-3030	FXD CER 3PF 500V TYPE 1
C375		52-01-3345	FXD CER 1000PF 10% 500V
C376		52-06-2225	FXD CER 100PF 10% 50V TYPE 1
C378		52-05-2468	FXD CER 0.01MF 50V
C379		52-05-2468	FXD CER 0.01MF 50V
C380		52-05-2468	FXD CER 0.01MF 50V
C401		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C402		52-05-2468	FXD CER 0.01MF 50V
C403		52-05-2468	FXD CER 0.01MF 50V
C404		54-00-0311	FXD ELECTROLYTIC 10MF 50V
C405		52-06-3205	FXD CER 68PF 10% 500V TYPE 1

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
C406		52-06-3205	FXD CER 68PF 10% 500V TYPE 1	
C407		57-10-1190	VAR CER 3-10PF	
C408		50-67-0060	FXD PLSTC FILM 0.1MF 10% 100V	
C409		50-67-0060	FXD PLSTC FILM 0.1MF 10% 100V	
C410		57-10-1190	VAR CER 3-10PF	
C411		56-48-1000	FXD CER EMI FILTER	
C412		56-48-1000	FXD CER EMI FILTER	
C413		56-48-1000	FXD CER EMI FILTER	
C414		52-06-3102	FXD CER 10PF 10% 500V TYPE 1	
C415		52-06-3102	FXD CER 10PF 10% 500V TYPE 1	
C416		52-06-3051	FXD CER 5PF 10% 500V TYPE 1	
C417		52-06-3051	FXD CER 5PF 10% 500V TYPE 1	
S101		82-70-8231	SWITCH LEVER	ALPS SLR823-1
S102		80-10-3040	SWITCH ROTARY VOLT/DIV	ALPS 1043
S201		82-70-8231	SWITCH LEVER	ALPS SLR823-1
S202		80-10-3040	SWITCH ROTARY VOLT/DIV	ALPS 1043
S311		82-70-8241	SWITCH LEVER	ALPS SLR824-1
A2 ASSEMBLY				
A2		90-50-2700	PCB A2 CH3 PREAMP	
Q301		31-20-2281	FET DUAL	SONY 2SK228-1-3
Q302		30-31-7301	TR SLICON NPN	NEC 2SC1730-L
Q303		30-31-7301	TR SLICON NPN	NEC 2SC1730-L
Q304		30-31-7301	TR SLICON NPN	NEC 2SC1730-L
Q305		30-31-7301	TR SLICON NPN	NEC 2SC1730-L
QCR301		30-31-9071	TR SILICON NPN	HITACHI 2SC1907
R301		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R302		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R303		42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W	
R304		42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W	
R305		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R306		42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R307		40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R308		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R309		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R310		40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R311		40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R312		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R313		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R314		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R316	*	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R317		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R318		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R319		40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R320		40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R321		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R322		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R323		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R324		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R325		40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
RV302		48-32-1500	VAR M GLAZE 150 OHM B	PV
RV303		48-32-1500	VAR M GLAZE 150 OHM B	PV
RV304		48-32-2100	VAR M GLAZE 1K OHM B	PV
C301		50-96-3590	FXD PLSTC FILM 0.022MF 20% 630V	
C302		57-10-1180	VAR CER 1.5-4PF	
C303		57-10-1190	VAR CER 3-10PF	
C304		52-06-3145	VAR CER 1.5-4PF	
C305		57-10-1180	VAR CER 1.5-4PF	
C306		50-87-0510	FXD PLSTC FILM 2200 20% 400V	
C307		54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C308		54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C311		50-67-0060	FXD PLSTC FILM 0.1MF 10% 100V	
C312		50-67-0060	FXD PLSTC FILM 0.1MF 10% 100V	
C314		52-05-2468	FXD CER 0.01MF 50V	
C315		52-05-2468	FXD CER 0.01MF 50V	
C316		57-10-1190	VAR CER 3-10PF	
C317		52-05-2468	FXD CER 0.01MF 50V	
S301		81-03-0130	PUSH SWITCH	
A3 ASSEMBLY				
A3		90-50-2710	PCB A3 VERT SWICH CONTROL	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR363	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q356	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q357	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q358	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
U306	35-70-0001	QUAD 2-INPUT POSI-NAND	
U307	35-70-1121	DUAL J-K F-F LOP	
U308	35-70-0001	QUAD 2-INPUT POSI-NAND	
U309	35-70-1121	DUAL J-K F-F LOP	
U310	35-70-0001	QUAD 2-INPUT POSI-NAND	
R1301	40-27-3122	FXD C FILM .12K OHM 5% 1/4W	
R1302	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1303	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R1304	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1306	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1307	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1308	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1309	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1310	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1311	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1312	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1313	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1314	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1315	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R1316	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1317	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1318	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1319	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1320	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1321	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1340	44-08-0010	FXD M GLAZE RESISTOR NETWORKS 10K OHM X8	
RV1301	46-16-3101	VAR M GLAZE 10K OHM B	
C381	52-01-3285	FXD CER 330PF 10% 500V	
C382	52-01-3285	FXD CER 330PF 10% 500V	
C383	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C384	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C385	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C386	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C387	52-06-3145	VAR CER 1.5-4PF	
S351	81-09-0000	PUSH SWITCH	ALPS SUE00
A4 ASSEMBLY			
A4	90 50-2721	PCB A4 VERT OUTPUT AMP	
CR441	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR442	32-92-0360	ZENER VZ=35.3-36.8	HITACHI HZ36L-2
CR443	32-92-0360	ZENER VZ=35.3-36.8	HITACHI HZ36L-2
CR444	32-92-0022	ZENER VZ=2.1-2.3	HITACHI HZ2B-3
CR445	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q441	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q442	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q443	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q444	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q445	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q446	30-32-5700	TR SILICON NPN	NEC 2SC2570
Q447	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q448	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q449	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q450	30-32-0550	TR SILICON NPN	MITUBISHI 2SC2055
Q451	30-32-0550	TR SILICON NPN	MITUBISHI 2SC2055
Q452	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q453	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q454	30-31-1640	TR SILICON NPN	TOSHIBA 2SC1164
Q455	30-31-1640	TR SILICON NPN	TOSHIBA 2SC1164
Q456	30-32-1201	TR SILICON NPN	TOSHIBA 2SC2120-Y
R441	40-27-0912	FXD C FILM 91 OHM 5% 1/4	
R442	40-27-0912	FXD C FILM 91 OHM 5% 1/4	
R444	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R445	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R446	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R447	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R448	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R449	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R450	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R451	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R452	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R453	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R454	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R455	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R456	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R457	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R458	42-72-1330	FXD M FILM 330 OHM 1% 1/4W	
R459	42-72-1330	FXD M FILM 330 OHM 1% 1/4W	
R460	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R461	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R462	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R463	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R464	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R465	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R466	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R467	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R468	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R469	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R470	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R471	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R472	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R473	40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R474	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R475	40-37-0331	FXD C FILM 33 OHM 5% 1/2W	
R476	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R477	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R478	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R479	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R480	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R481	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R482	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R483	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R484	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R485	44-92-1270	FXD M OXIDE 270 OHM 5% 2W	
R486	44-92-1220	FXD M OXIDE 220 OHM 5% 2W	
R487	44-92-1220	FXD M OXIDE 220 OHM 5% 2W	
R488	44-92-1270	FXD M OXIDE 270 OHM 5% 2W	
R489	40-37-3221	FXD C FILM 22K OHM 5% 1/2W	
R490	40-37-3221	FXD C FILM 22K OHM 5% 1/2W	
R493	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R494	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R495	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R496	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R497	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R498	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R499	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
RV441	48-31-1100	VAR M GLAZE 100 OHM B	PH
RV442	48-31-2100	VAR M GLAZE 1K OHM B	PH
RV443	48-31-3100	FXD M GLASE 10K OHM B	PH
RV444	48-31-3500	VAR M GLAZE 50K OHM B	PH
RV445	48-31-1100	VAR M GLAZE 100 OHM B	PH
RV446	48-31-3200	VAR M GLAZE 20K OHM B	PH
C441	52-06-3030	FXD CER 3PF 500V TYPE 1	
C442	52-06-3030	FXD CER 3PF 500V TYPE 1	
C443	52-05-2468	FXD CER 0.01MF 50V	
C444	52-06-3145	VAR CER 1.5-4PF	
C445	57-10-1150	VAR CER 2.5-22.5PF	
C446	57-10-1150	VAR CER 2.5-22.5PF	
C447	57-10-1170	VAR CER 5-55PF	
C448	52-06-2245	FXD CER 150PF 10% 50V TYPE 1	
C449	52-01-3345	FXD CER 1000PF 10% 500V	
C450	52-05-2468	FXD CER 0.01MF 50V	
C451	52-06-3145	VAR CER 1.5-4PF	
C452	52-05-2468	FXD CER 0.01MF 50V	
C453	52-01-3345	FXD CER 1000PF 10% 500V	
C454	52-05-2468	FXD CER 0.01MF 50V	
C455	52-01-3345	FXD CER 1000PF 10% 500V	
C456	52-05-2468	FXD CER 0.01MF 50V	
C457	52-01-3345	FXD CER 1000PF 10% 500V	
C458	52-01-3345	FXD CER 1000PF 10% 500V	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
C459		54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C460		52-01-3345	FXD CER 1000PF 10% 500V	
C461		52-01-3345	FXD CER 1000PF 10% 500V	
C462		52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C463		52-01-3385	FXD CER 2220PF 10% 500V	
C464	*	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C465		54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C466		52-05-2468	FXD CER 0.01MF 50V	
DL441		91-90-0004	DELAY LINE IM Z=186 OHM	
L1101		66-21-0050	ROTATION COIL KIKUSUI S7901184	
A5 ASSEMBLY				
A5		90-50-2730	PCB A5 CAL & CRT CONTROL	
CR1201		37-00-0060	LAMP LED GREEN	TOSHIBA TLG-105
Q1201		30-30-9451	TR SILICON NPN	NEC 2SC945-Q
U1101		35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA TC4011BP
R1181		40-27-3822	FXD C FILM 82K OHM 5% 1/4W	
R1182		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1183		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1184		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1185		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1186		40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R1187		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1188		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1189		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1190		42-72-2820	FXD M FILM 8.2K OHM 1% 1/4W	
R1191		42-72-2180	FXD M FILM 1.8K OHM 1% 1/4W	
R1192		42-71-1200	FXD M FILM 220 OHM 1% 1/4W 100PPM/DEG	
R1193		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1201		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R1202		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1203		40-27-3682	FXD C FILM 68K OHM 5% 1/4W	
R1204		40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
RV1181		48-32-4100	VAR M GLAZE 100K OHM B	
RV1182		48-32-2200	VAR M GLAZE 2K OHM B	
RV1202		46-16-3102	VAR M GLAZE 10K OHM B	
RV1203		46-16-4102	VAR M GLAZE 100K OHM B	
RV1204		46-16-2502	VAR M GLAZE 5K OHM B	
RV1205		46-16-2502	VAR M GLAZE 5K OHM B	
C1181		50-45-0500	FXD PLSTC FILM 0.01MF 10% 50V	
C1182		50-45-0500	FXD PLSTC FILM 0.01MF 10% 50V	
C1183		52-06-3051	FXD CER 5PF 10% 500V TYPE 1	
C1184		52-01-3345	FXD CER 1000PF 10% 500V	
C1185		54-00-0311	FXD ELECTROLYTIC 10MF 50V	
DS1201		23-35-0020	LAMP FILAMENT 6.3V 150MA	
DS1202		23-35-0020	LAMP FILAMENT 6.3V 150MA	
DS1203		23-35-0020	LAMP FILAMENT 6.3V 150MA	
S1201		81-01-0270	PUSH SWICH	ALPS SDG5P-E
A6 ASSEMBLY				
A6		90-50-2740	PCB A6 TRIG & SWEEP CONTROL	
CR702		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR703		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR704		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR705		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR706		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR707		32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR709		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR712		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR713		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR714		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR715		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1001		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1002		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1003		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1005		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR1006	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q571	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q572	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q573	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q701	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q702	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q703	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q704	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q705	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q706	31-90-0041	FET DUAL	NEC UPA63H-1
Q707	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q1001	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1002	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1003	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1004	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1005	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q1006	30-11-0151	TR SILICON PNP	TOSHIBA 2SA1015-Y
Q1007	30-11-0151	TR SILICON PNP	TOSHIBA 2SA1015-Y
Q1008	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1009	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1010	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1011	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1012	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1013	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1014	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
U504	35-29-0000	TRIPLE LINE RECEIVER	HITACHI HD10116
U505	35-20-0000	QUAD 2-INPUT NOR	HITACHI HD10102
U604	35-29-0000	TRIPLE LINE RECEIVER	HITACHI HD10116
U701	35-70-1231	DUAL RETRIG MONO-MULTI	
U702	35-70-1231	DUAL RETRIG MONO-MULTI	
U703	34-69-0010	QUAD BILATERAL SWITCH	TOSHIBA TC4066BP
U704	35-23-0000	DUAL D FLIP FLOP	HITACHI HD10131
U705	35-20-0000	QUAD 2-INPUT NOR	HITACHI HD10102
U706	35-29-0000	TRIPLE LINE RECEIVER	HITACHI HD10116
U707	35-23-0000	DUAL D FLIP FLOP	HITACHI HD10131
U708	35-20-0000	QUAD 2-INPUT NOR	HITACHI HD10102
U709	34-00-0215	J-FET INPUT OP AMP	
U1001	35-70-0001	QUAD 2-INPUT POSI-NAND	
U1002	35-70-0741	DUAL D-FLIP-FLOP	
R571	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R572	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R573	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R574	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R575	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R576	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R577	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R578	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R579	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R580	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R581	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R582	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R584	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R585	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R586	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R587	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R588	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R589	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R590	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R591	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
R592	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
R681	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R682	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R683	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R684	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R685	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
R701	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R702	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R703	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R704	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R705	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R706	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R707	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R708	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R709	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R710	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R711	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R712	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R713	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R714	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R715	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R716	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R717	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R718	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R719	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R720	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R721	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R722	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R723	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R724	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R725	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R726	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R727	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R728	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R729	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R730	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R731	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R732	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R734	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R735	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R736	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R737	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R738	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R739	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R740	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R742	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R743	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R744	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R745	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R746	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R747	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R748	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R749	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R750	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R751	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R752	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R754	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R755	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R756	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R771	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R772	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R773	42-72-2220	FXD M FILM 2.2K OHM 1% 1/4W
R774	42-72-3100	FXD M FILM 10K OHM 1% 1/4W
R775	42-72-2560	FXD M FILM 5.6K OHM 1% 1/4W
R776	42-72-1220	FXD M FILM 220 OHM 1% 1/4W
R777	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R778	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R779	40-37-3221	FXD C FILM 22K OHM 5% 1/2W
R780	40-37-3101	FXD C FILM 10K OHM 5% 1/2W
R781	40-37-3221	FXD C FILM 22K OHM 5% 1/2W
R782	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R783	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R784	40-27-3562	FXD C FILM 56K OHM 5% 1/4W
R785	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R786	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R787	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R788	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R1001	42-72-2180	FXD M FILM 1.8K OHM 1% 1/4W
R1002	42-72-2180	FXD M FILM 1.8K OHM 1% 1/4W
R1003	42-72-2180	FXD M FILM 1.8K OHM 1% 1/4W
R1004	42-72-2180	FXD M FILM 1.8K OHM 1% 1/4W
R1005	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R1006	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R1007	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R1008	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R1009	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R1010	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R1011	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1012	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R1013	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R1014	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R1015	40-27-2102	FXD C FILM 1K OHM 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R1017	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1018	42-72-2330	FXD M FILM 3.3K OHM 1% 1/4W	
R1019	42-72-1390	FXD M FILM 390 OHM 1% 1/4W	
R1020	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1021	40-27-3272	FXD C FILM 27K OHM 5% 1/4W	
R1022	42-72-1390	FXD M FILM 390 OHM 1% 1/4W	
R1023	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W	
R1024	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W	
R1025	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W	
R1026	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R1027	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W	
R1028	40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R1029	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R1030	40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R1031	42-72-2100	FXD M FILM 1K OHM 1% 1/4W	
R1032	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R1033	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R1034	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R1035	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1036	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1037	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1038	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1039	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1040	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1041	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1042	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1043	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R1044	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1045	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
RV701	48-32-2100	VAR M GLAZE 1K OHM B	PV
RV702	48-32-2100	VAR M GLAZE 1K OHM B	PV
RV703	48-29-2200	VAR M GLAZE 2K OHM	
RV704	48-29-3100	VAR M GLAZE 10K OHM	
RV1003	48-32-2100	VAR M GLAZE 1K OHM B	PV
RV1004	48-32-2100	VAR M GLAZE 1K OHM B	PV
RV1005	48-32-1100	VAR M GLAZE 100 OHM B	PV
C571	55-37-2050	FXD TANT ELECT 1MF 35V	
C572	50-67-0050	FXD PLSTC FILM 0.047MF 10% 100V	
C573	55-37-2000	FXD TANT ELECT 0.1MF 35V	
C574	52-06-3145	VAR CER 1.5-4PF	
C575	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C576	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C681	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C701	55-37-2050	FXD TANT ELECT 1MF 35V	
C702	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C703	55-37-2050	FXD TANT ELECT 1MF 35V	
C704	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C705	55-37-2050	FXD TANT ELECT 1MF 35V	
C706	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C707	52-06-3102	FXD CER 10PF 10% 500V TYPE 1	
C708	52-06-3030	FXD CER 3PF 500V TYPE 1	
C711	52-06-2215	FXD CER 82PF 10% 500V TYPE 1	
C713	52-06-2215	FXD CER 82PF 10% 500V TYPE 1	
C715	52-05-2468	FXD CER 0.01MF 50V	
C716	52-05-2468	FXD CER 0.01MF 50V	
C717	52-05-2468	FXD CER 0.01MF 50V	
C718	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C720	52-05-1498	FXD CER 0.1MF 25V	
C721	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C722	52-05-1498	FXD CER 0.1MF 25V	
C723	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C724	52-05-1498	FXD CER 0.1MF 25V	
C771	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C772	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C773	55-37-2050	FXD TANT ELECT 1MF 35V	
C775	55-37-2050	FXD TANT ELECT 1MF 35V	
C1001	54-00-0114	FXD ELECTROLYTIC 47MF 25V	
C1002	54-00-0114	FXD ELECTROLYTIC 47MF 25V	
C1003	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C1005	54-00-0114	FXD ELECTROLYTIC 47MF 25V	
C1007	52-05-2468	FXD CER 0.01MF 50V	
C1008	52-05-2468	FXD CER 0.01MF 50V	
C1009	52-05-2468	FXD CER 0.01MF 50V	
C1011	52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C1012	54-00-0311	FXD ELECTROLYTIC 10MF 50V	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R835	42-71-3100	FXD M FILM 10K OHM 0.5% 1/4W	
R836	42-71-2100	FXD M FILM 1K OHM 0.5 1/4W	
R837	42-72-2120	FXD M FILM 1.2K OHM 1% 1/4W	
R838	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R839	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R840	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R841	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R842	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R843	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R844	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R845	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R846	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R847	44-07-0110	FXD M GLAZE RESISTOR NETWORKS 100K OHM X10	
R848	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R851	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R852	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R853	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R855	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R856	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R857	40-27-0822	FXD C FILM 82 OHM 5% 1/4W	
RV501	45-01-0560	VAR C COMP 10K/100K OHM B	
RV503	48-32-1500	VAR M GLAZE 150 OHM B	PV
RV801	48-30-3100	VAR M GLAZE 10K OHM	
RV802	48-30-3100	VAR M GLAZE 10K OHM	
C501	57-10-1180	VAR CER 1.5-4PF	
C502	57-10-1190	VAR CER 3-10PF	
C503	52-06-3145	VAR CER 1.5-4PF	
C504	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100V	
C505	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C506	52-01-3385	FXD CER 2220PF 10% 500V	
C507	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C508	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C509	52-06-3102	FXD CER 10PF 10% 500V TYPE 1	
C510	52-06-2265	FXD CER 220PF 10% 50V TYPE 1	
C511	55-37-2050	FXD TANT ELECT 1MF 35V	
C512	55-37-2050	FXD TANT ELECT 1MF 35V	
C513	52-05-2468	FXD CER 0.01MF 50V	
C514	52-05-2468	FXD CER 0.01MF 50V	
C515	52-05-2468	FXD CER 0.01MF 50V	
C516	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C517	52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C518	52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C521	56-48-1000	FXD CER EMI FILTER	
C522	56-48-1000	FXD CER EMI FILTER	
C523	56-48-1000	FXD CER EMI FILTER	
C524	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100V	
C582	57-10-1190	VAR CER 3-10PF	
C585	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C801	52-05-2468	FXD CER 0.01MF 50V	
C804	54-00-0301	FXD ELECTROLYTIC 1MF 50V	
C805	52-05-2468	FXD CER 0.01MF 50V	
C806	52-06-2265	FXD CER 220PF 10% 50V TYPE 1	
C807	52-05-2468	FXD CER 0.01MF 50V	
C811	50-65-3550	FXD PLSTC FILM 1MF 10% 200V	
C812	50-45-1500	FXD PLSTC FILM 0.01MF 10% 50V	
C813	52-06-2215	FXD CER 82PF 10% 500V TYPE 1	
C814	57-10-1150	VAR CER 2.5-22.5PF	
C816	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C817	52-05-2468	FXD CER 0.01MF 50V	
C818	52-05-2468	FXD CER 0.01MF 50V	
C819	54-00-0114	FXD ELECTROLYTIC 47MF 25V	
C820	52-05-2468	FXD CER 0.01MF 50V	
S501	82-70-5242	LEVER SWICH	ALPS SLR524-2
S502	82-70-5242	LEVER SWICH	ALPS SLR524-2
S505	82-70-5222	PUSH SWITCH	ALPS SLR522-2
A8 ASSEMBLY			
A8	90-50-2760	PCB A8 B TRIG & B	
CR901	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR902	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR903	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR904	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR905	32-92-0033	ZENER VZ=2.1-2.3	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR906	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q601	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q602	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q603	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q604	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q605	30-31-8431	TR SILICON NPN	NEC 2SC1843-E
Q606	31-20-2281	FET DUAL	SONY 2SK228-1-3
Q607	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q608	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q609	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q610	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q611	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q612	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q613	30-31-7301	TR SLICON NPN	NEC 2SC1730-L
Q614	30-31-7301	TR SLICON NPN	NEC 2SC1730-L
Q901	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q902	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q903	31-20-1073	FET	SONY 2SK107-3
Q904	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q905	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q906	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q907	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q908	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q909	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q910	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q911	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q912	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q913	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q914	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q915	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q916	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q917	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
QCR601	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
U601	30-90-0150	TRANSISTOR ARRAYS 5 NPN	
U602	34-00-0215	J-FET INPUT OP AMP	
U603	30-90-0140	TRANSISTOR ARRAYS 5 NPN	
U901	34-00-0215	J-FET INPUT OP AMP	
U902	34-69-0010	QUAD BILATERAL SWITCH	TOSHIBA TC4066BP
U903	35-60-0080	HEX INV BUFFER/CONV	TOSHIBA TC4009UBP
U904	35-60-0100	TRIPLE 3-INPUT NAND GATE	TOSHIBA TC4023BP
U905	35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA TC4011BP
R601	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R602	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R603	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R604	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R605	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R606	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R607	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R608	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R609	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R610	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R612	42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W	
R613	42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W	
R614	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R615	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R616	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R617	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R618	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R619	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R620	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R621	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R622	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R623	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R624	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R625	40-27-3152	FXD C FILM 15K OHM 5% 1/4W	
R628	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R629	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R630	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R631	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R632	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R633	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R634	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R635	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R636	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R637	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R638	40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R639	40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R640	40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R641	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R642	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R643	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R644	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R645	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R646	40-27-1272	FXD C FILM 270 OHM 5% 1/4W
R647	40-27-1272	FXD C FILM 270 OHM 5% 1/4W
R648	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R649	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R650	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R651	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R652	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R653	40-27-0272	FXD C FILM 27 OHM 5% 1/4W
R654	40-27-4472	FXD C FILM 470K OHM 5% 1/4W
R661	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R662	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R663	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R665	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R666	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R668	42-72-1680	FXD M FILM 680 OHM 1% 1/4W
R669	42-72-1680	FXD M FILM 680 OHM 1% 1/4W
R671	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R901	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R902	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R903	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R904	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R905	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R906	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R907	42-72-2560	FXD M FILM 5.6K OHM 1% 1/4W
R908	42-72-2560	FXD M FILM 5.6K OHM 1% 1/4W
R909	42-72-3100	FXD M FILM 10K OHM 1% 1/4W
R910	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R911	42-71-3500	FXD M FILM 50K OHM 0.5% 1/4W100PPM/DEG
R912	42-71-3200	FXD M FILM 20K OHM 0.5% 1/4W
R913	42-71-3100	FXD M FILM 10K OHM 0.5% 1/4W
R914	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R915	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG
R916	42-71-4100	FXD M FILM 100K OHM 0.5% 1/4W
R917	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R918	42-71-3100	FXD M FILM 10K OHM 0.5% 1/4W
R919	42-71-2100	FXD M FILM 1K OHM 0.5 1/4W
R920	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R921	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R922	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R923	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R924	42-72-2110	FXD M FILM 1.1K OHM 0.5% 1/4W
R925	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R926	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R927	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R928	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R929	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R930	44-07-0110	FXD M GLAZE RESISTOR NETWORKS 100K OHM X10
R931	40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R932	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R933	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R934	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R935	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R936	40-27-1272	FXD C FILM 270 OHM 5% 1/4W
R937	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R938	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R941	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R942	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R943	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
RV661	48-32-1500	VAR M GLAZE 150 OHM B PV
RV662	48-30-3100	VAR M GLAZE 10K OHM
RV663	48-27-3100	VAR M GLAZE 10K OHM
SW1	45-01-0550	VAR C COMP 10K/100K OHM B
C671	57-10-1180	VAR CER 1.5-4PF
C672	57-10-1190	VAR CER 3-10PF

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
C613	52-06-3165	FXD CER 33PF 10% 500V TYPE 1	
C614	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100V	
C615	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C616	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C617	52-01-3385	FXD CER 2220PF 10% 500V	
C618	52-05-2468	FXD CER 0.01MF 50V	
C619	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C620	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C621	52-06-3102	FXD CER 10PF 10% 500V TYPE 1	
C622	52-06-2265	FXD CER 220PF 10% 50V TYPE 1	
C623	55-37-2050	FXD TANT ELECT 1MF 35V	
C624	55-37-2050	FXD TANT ELECT 1MF 35V	
C625	52-05-2468	FXD CER 0.01MF 50V	
C626	52-05-2468	FXD CER 0.01MF 50V	
C627	52-05-2468	FXD CER 0.01MF 50V	
C628	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C629	52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C630	52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C662	57-10-1190	VAR CER 3-10PF	
C665	52-06-3185	FXD CER 47PF 10% 500V TYPE 1	
C667	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C668	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C669	56-48-1000	FXD CER EMI FILTER	
C670	56-48-1000	FXD CER EMI FILTER	
C671	56-48-1000	FXD CER EMI FILTER	
C901	50-65-3550	FXD PLSTC FILM 1MF 10% 200V	
C902	50-45-1500	FXD PLSTC FILM 0.01MF 10% 50V	
C903	52-06-2215	FXD CER 82PF 10% 500V TYPE 1	
C904	57-10-1150	VAR CER 2.5-22.5PF	
C905	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C906	52-05-2468	FXD CER 0.01MF 50V	
C907	52-05-2468	FXD CER 0.01MF 50V	
C908	52-05-2468	FXD CER 0.01MF 50V	
C909	54-00-0114	FXD ELECTROLYTIC 47MF 25V	
C910	52-05-2468	FXD CER 0.01MF 50V	
C911	52-05-2468	FXD CER 0.01MF 50V	
C912	52-05-1498	FXD CER 0.1MF 25V	
C913	52-05-1498	FXD CER 0.1MF 25V	
C914	52-03-3469	FXD CER 0.01MF +100-0% 500V	
S601	82-70-5242	LEVER SWICH	ALPS SLR524-2
S602	82-70-5242	LEVER SWICH	ALPS SLR524-2
S604	82-70-5221	PUSH SWITCH	ALPS SLR522-1
A9 ASSEMBLY			
A9	90-50-2770	PCB A9 HORIZ OUTPUT AMP	
CR1053	32-92-0022	ZENER VZ=2.1-2.3	HITACHI HZ2B-3
Q1051	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q1052	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q1053	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1054	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1055	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1056	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1057	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q1058	30-11-0051	TR SILICON PNP	NEC 2SA1005-L
Q1059	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q1060	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q1061	30-40-6681	TR SILICON NPN	HITACHI 2SD668A-C
Q1062	30-40-6681	TR SILICON NPN	HITACHI 2SD668A-C
Q1063	30-20-6481	TR SILICON PNP	HITACHI 2SB648A
Q1064	30-20-6481	TR SILICON PNP	HITACHI 2SB648A
Q1065	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
QCR1052	30-31-7301	TR SLICON NPN	NEC 2SC1730-L
QCR1051	30-31-7301	TR SLICON NPN	NEC 2SC1730-L
R1051	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1052	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1053	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R1054	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1055	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R1056	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1057	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1058	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R1059	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R1060	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R1061	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R1062	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1063	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1064	40-27-1822	FXD C FILM 820 OHM 5% 1/4W	
R1065	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1066	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1067	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1068	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R1069	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R1070	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1071	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1072	40-27-3332	FXD C FILM 33K OHM 5% 1/4W	
R1073	40-27-3332	FXD C FILM 33K OHM 5% 1/4W	
R1074	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1075	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1076	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1077	44-91-3470	FXD M OXIDE 47K OHM 5% 1W	
R1078	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1079	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1080	44-91-3470	FXD M OXIDE 47K OHM 5% 1W	
R1081	40-27-4152	FXD C FILM 150K OHM 5% 1/4W	
R1082	40-27-4152	FXD C FILM 150K OHM 5% 1/4W	
R1083	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1084	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1085	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R1086	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R1087	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R1088	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R1089	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R1090	44-91-3680	FXD M OXIDE 68K OHM 5% 1W	
R1091	44-91-3680	FXD M OXIDE 68K OHM 5% 1W	
R1092	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1093	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1094	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1095	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1096	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
RV1051	48-31-2200	VAR M GLAZE 2K OHM B	PH
RV1052	48-31-2500	VAR M GLAZE 5K OHM B	PH
C1051	52-05-2468	FXD CER 0.01MF 50V	
C1052	52-05-2468	FXD CER 0.01MF 50V	
C1055	52-06-2225	FXD CER 100PF 10% 50V TYPE 1	
C1056	52-05-2468	FXD CER 0.01MF 50V	
C1057	57-10-1150	VAR CER 2.5-22.5PF	
C1058	52-96-1140	FXD CER 0.47PF	
C1059	52-96-1140	FXD CER 0.47PF	
C1060	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C1061	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C1062	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C1063	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1064	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1065	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1066	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1067	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1068	52-05-1498	FXD CER 0.1MF 25V	
C1071	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1072	52-05-1498	FXD CER 0.1MF 25V	
C1073	52-05-1498	FXD CER 0.1MF 25V	
C1074	52-05-1498	FXD CER 0.1MF 25V	
C1075	52-05-2468	FXD CER 0.01MF 50V	
C1076	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C1077	52-05-2468	FXD CER 0.01MF 50V	
A10 ASSEMBLY			
A10	90-50-2780	PCB A10 H.V & CRT CIRCUIT	
CR1101	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1102	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1103	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR1104	32-92-0360	ZENER VZ=35.3-36.8	HITACHI HZ36L-2
CR1105	32-90-1820	DIODE VR=2KV FAST RECOVERY	HITACHI ERB-20
CR1106	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR1107	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR1108	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR1109	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83

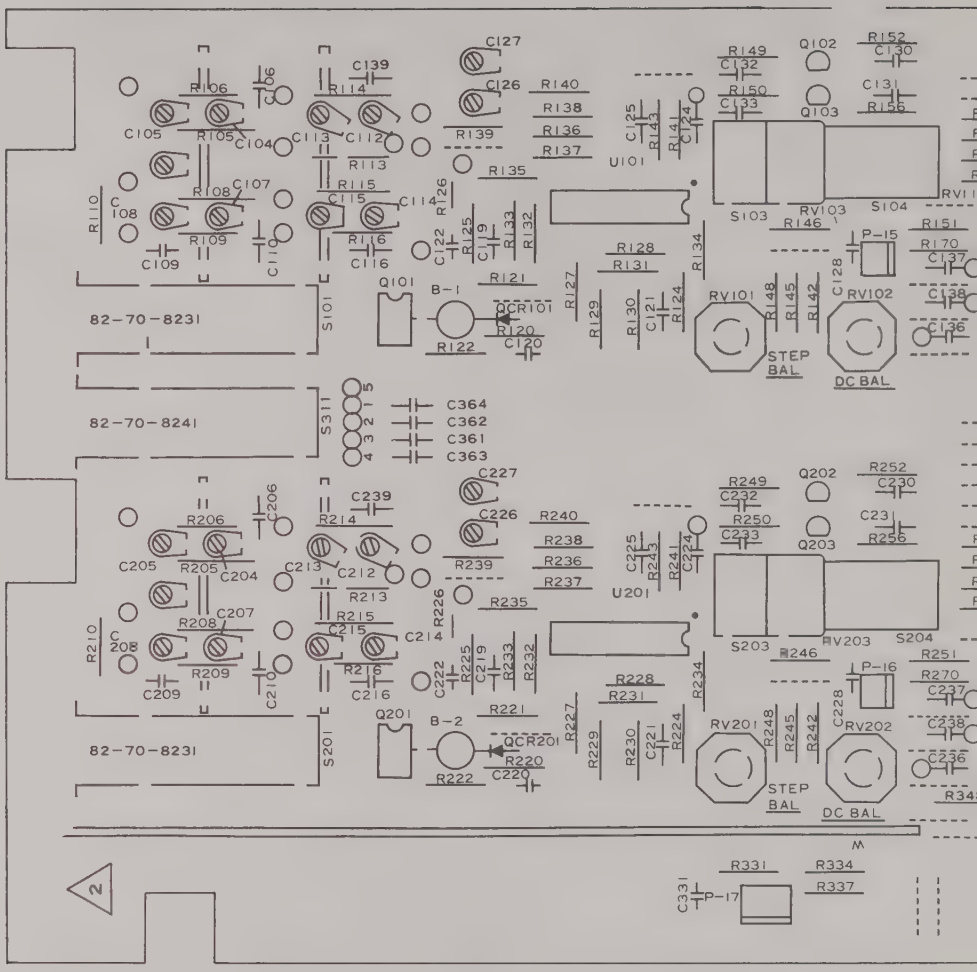
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR1110	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR1111	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR1112	32-92-0130	ZENER VZ=12.41-13.05	NEC RD13JB1
Q1101	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1102	30-31-8431	TR SILICON NPN	NEC 2SC1843-E
Q1103	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1104	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1106	30-32-3710	TR SILICON NPN	NEC 2SC2371-L
Z1101	39-00-0130	SURGE ABSORBER	ERZ-C10DK361
R1101	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1102	42-72-2560	FXD M FILM 5.6K OHM 1% 1/4W	
R1103	42-72-2680	FXD M FILM 6.8K OHM 1% 1/4W	
R1104	42-72-3560	FXD M FILM 56K OHM 1% 1/4W	
R1105	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1106	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1107	40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R1108	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R1109	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R1110	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1111	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1112	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W	
R1113	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R1114	42-44-0280	FXD M GLAZE 10M OHM 1% 1/6W	
R1115	42-44-0280	FXD M GLAZE 10M OHM 1% 1/6W	
R1116	40-37-3221	FXD C FILM 22K OHM 5% 1/2W	
R1118	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R1119	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R1120	40-27-4152	FXD C FILM 150K OHM 5% 1/4W	
R1121	42-44-0280	FXD M GLAZE 10M OHM 1% 1/6W	
R1122	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R1123	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R1124	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R1125	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R1126	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R1127	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R1128	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1131	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1132	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1133	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
RV1101	48-32-3100	VAR M GLAZE 10K OHM B	FV
RV1102	48-26-5220	VAR M GLAZE 2.2M OHM	
RV1103	48-26-4101	VAR M GLAZE 100K OHM	
RV1104	48-26-4101	VAR M GLAZE 100K OHM	
RV1105	48-26-4101	VAR M GLAZE 100K OHM	
C1101	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
C1102	55-37-2050	FXD TANT ELECT 1MF 35V	
C1103	50-67-0060	FXD PLSTC FILM 0.1MF 10% 100V	
C1104	54-00-0121	FXD ELECTROLYTIC 100MF 25V	
C1105	54-00-0121	FXD ELECTROLYTIC 100MF 25V	
C1106	52-98-1000	FXD CER 4700PF +80-20% 3.15KV	
C1107	52-98-1000	FXD CER 4700PF +80-20% 3.15KV	
C1108	52-98-1000	FXD CER 4700PF +80-20% 3.15KV	
C1109	52-98-1000	FXD CER 4700PF +80-20% 3.15KV	
C1110	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1111	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1112	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1113	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1114	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1115	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1116	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1117	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1118	52-03-3469	FXD CER 0.01MF +100-0% 500V	
C1119	52-08-5145	FXD CER 22PF 2KV	
C1120	52-03-3469	FXD CER 0.01MF +100-0% 500V	
T1101	63-92-0130	DC-DC CONVERTOR TRANS	KIKUSUI SB101152
A11 ASSEMBLY			
A11	90-50-2790	PCB A11 POWER SUPPLY & Z AMP	
CR1141	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1142	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR1144	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1145	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1146	32-92-0022	ZENER VZ=2.1-2.3	HITACHI HZ2B-3
CR1211	32-90-0870	DIODE BRIDGE	SHINDENGEN S1VB40
CR1212	32-90-0520	DIODE	HITACHI V06G
CR1213	32-90-0520	DIODE	HITACHI V06G
CR1214	32-90-0520	DIODE	HITACHI V06G
CR1215	32-90-0520	DIODE	HITACHI V06G
CR1216	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1217	32-90-1152	DIODE BRIDGE VRM=200V IO=2A	TOSHIBA 2D4B41
CR1218	32-90-1152	DIODE BRIDGE VRM=200V IO=2A	TOSHIBA 2D4B41
Q1141	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q1142	30-10-8381	TR SILICON PNP	MATUSHITA 2SA838-B
Q1143	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
Q1145	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1146	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1147	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1148	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1149	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1150	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1151	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1152	30-31-9071	TR SILICON NPN	HITACHI 2SC1907
Q1153	30-40-6681	TR SILICON NPN	HITACHI 2SD668A-C
Q1154	30-40-6681	TR SILICON NPN	HITACHI 2SD668A-C
Q1155	30-20-6481	TR SILICON PNP	HITACHI 2SB648A
Q1156	30-20-6481	TR SILICON PNP	HITACHI 2SB648A
Q1213	30-32-3710	TR SILICON NPN	NEC 2SC2371-L
Q1214	30-10-8441	TR SILICON PNP	HITACHI 2SA844-D
Q1217	30-30-9451	TR SILICON NPN	NEC 2SC945-Q
U1211	34-00-0240	DUAL OP-AMP	NEC UPC4558C
U1212	34-40-0070	DUAL +/-15V TRACKING	TOSHIBA TA7179P
R1141	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R1142	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R1143	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R1144	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R1145	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R1146	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W	
R1147	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1148	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R1149	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R1150	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R1151	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1152	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1153	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1154	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R1155	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R1156	40-27-3332	FXD C FILM 33K OHM 5% 1/4W	
R1157	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1158	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1159	44-91-3560	FXD M OXIDE 56K OHM 5% 1W	
R1160	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1161	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1162	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1163	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R1164	40-27-4152	FXD C FILM 150K OHM 5% 1/4W	
R1165	40-27-4152	FXD C FILM 150K OHM 5% 1/4W	
R1166	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1167	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R1168	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1169	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1170	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1171	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1172	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R1173	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R1174	44-91-3680	FXD M OXIDE 68K OHM 5% 1W	
R1175	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1176	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1177	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R1178	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1179	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1211	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R1212	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W	
R1213	40-37-3103	FXD C FILM 10K OHM 5% 1/2W	
R1214	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	

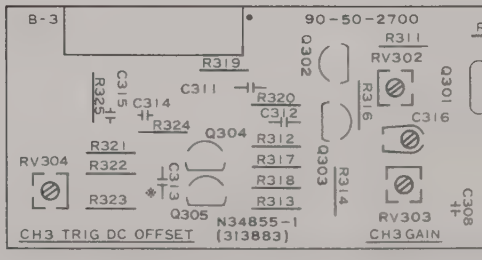
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R1215	42-72-4100	FXD M FILM 100K OHM 1% 1/4W
R1216	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R1217	42-72-3470	FXD M FILM 47K OHM 1% 1/4W
R1218	40-27-3472	FXD C FILM 47K OHM 5% 1/4W
R1219	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1220	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1221	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R1222	42-72-3560	FXD M FILM 56K OHM 1% 1/4W
R1223	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R1224	44-92-0680	FXD M OXIDE 68 OHM 5% 2W
R1225	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R1226	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R1227	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R1228	42-72-1680	FXD M FILM 680 OHM 1% 1/4W
R1229	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R1230	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R1231	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R1232	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R1233	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R1234	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R1235	44-92-0680	FXD M OXIDE 68 OHM 5% 2W
R1236	44-92-0680	FXD M OXIDE 68 OHM 5% 2W
R1237	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R1238	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R1239	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R1240	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R1241	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W
R1242	42-72-2910	FXD C FILM 9.1K OHM 1% 1/4W
R1243	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R1245	40-27-4102	FXD C FILM 100K OHM 5% 1/4W
RV1141	48-31-3100	FXD M GLASE 10K OHM B PH
RV1142	48-31-3100	FXD M GLASE 10K OHM B PH
RV1211	48-29-2100	VAR M GLAZE 1K OHM
C1141	54-00-0311	FXD ELECTROLYTIC 10MF 50V
C1142	52-06-3145	VAR CER 1.5-4PF
C1143	52-05-2468	FXD CER 0.01MF 50V
C1144	57-10-1190	VAR CER 3-10PF
C1145	52-96-1140	FXD CER 0.47PF
C1146	52-96-1140	FXD CER 0.47PF
C1147	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1148	52-05-2468	FXD CER 0.01MF 50V
C1149	52-05-2468	FXD CER 0.01MF 50V
C1150	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1151	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1152	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1153	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1154	52-05-1498	FXD CER 0.1MF 25V
C1155	52-05-2468	FXD CER 0.01MF 50V
C1156	52-05-2468	FXD CER 0.01MF 50V
C1157	52-05-2468	FXD CER 0.01MF 50V
C1158	54-00-0311	FXD ELECTROLYTIC 10MF 50V
C1159	52-06-3125	FXD CER 15PF 10% 500V TYPE 1
C1160	52-05-2468	FXD CER 0.01MF 50V
C1161	54-00-0311	FXD ELECTROLYTIC 10MF 50V
C1211	50-67-0040	FXD PLSTC FILM 0.022MF 10% 100V
C1213	54-60-1601	FIXD ELECTROLYTIC 47MF 160V
C1214	54-60-1550	FXD ELECTROLYTIC 1MF 160V
C1216	54-00-0522	FXD ELECTROLYTIC 22MF 100V
C1217	54-60-1550	FXD ELECTROLYTIC 1MF 160V
C1218	54-30-1650	FXD ELECTROLYTIC 2200MF 25V
C1219	54-30-1650	FXD ELECTROLYTIC 2200MF 25V
C1220	54-30-1650	FXD ELECTROLYTIC 2200MF 25V
C1223	54-00-0311	FXD ELECTROLYTIC 10MF 50V
C1224	52-01-3345	FXD CER 1000PF 10% 500V
C1225	52-01-3345	FXD CER 1000PF 10% 500V
C1226 *	52-05-2468	FXD CER 0.01MF 50V
C1228	54-00-0311	FXD ELECTROLYTIC 10MF 50V
C1229	54-00-0032	FXD ELECTROLYTIC 2200MF 16V
C1231	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1232	52-03-3469	FXD CER 0.01MF +100-0% 500V
C1233	52-05-1498	FXD CER 0.1MF 25V
C1234	52-05-1498	FXD CER 0.1MF 25V
C1235	52-05-1498	FXD CER 0.1MF 25V
C1236	52-05-2468	FXD CER 0.01MF 50V
C1237	52-01-3385	FXD CER 2220PF 10% 500V

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
C1239	54-60-1550	FXD ELECTROLYTIC 1MF 160V	
C1240	54-00-0311	FXD ELECTROLYTIC 10MF 50V	
A12 ASSEMBLY			
A12	90-50-2800	PCB A12 H.V MULTI	
CR1121	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1122	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1123	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1124	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1125	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1126	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1127	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1128	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1129	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
CR1130	32-90-1950	DIODE VR=6KV FAST RECOVERY	HITACHI Y10GA
R1130	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
C1121	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1122	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1123	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1124	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1125	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1126	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1127	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1128	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1129	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
C1130	52-98-1010	FXD CER 1000PF +80-20% 6.3KV	
A13 ASSEMBLY			
A13	90-50-2810	PCB A13 INTEN VR	
RV1201	45-01-0530	VAR C COMP 5K OHM B	
A14 ASSEMBLY			
A14	90-50-2820	PCB A14 SWEEP MODE SWICH	
CR721	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR722	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR723	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
R791	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R792	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R793	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
C791	52-01-3345	FXD CER 1000PF 10% 500V	
S701	81-03-0270	PUSH SWITCH	ALPS SUE30
A15 ASSEMBLY			
A15	90-50-2840	PCB A15 SWEEP VARIABLE	
RV803	80-99-0060	SWITCH ROTARY TIME/DIV	ALPS
B ASSEMBLY			
CR331	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR710	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR711	37-00-0092	LAMP LED GREEN	TOSHIBA TLG102KW
CR810	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
Q1105	30-40-8802	TR SILICON NPN	NEC 2SD880-Y
Q1211	30-31-5051	TR SILICON NPN	NEC 2SC1505-K
Q1212	30-20-8341	TR SILICON PNP	TOSHIBA 2SB834-Y
Q1215	30-20-8341	TR SILICON PNP	TOSHIBA 2SB834-Y
Q1216	30-40-8802	TR SILICON NPN	NEC 2SD880-Y
Q1218	30-40-8802	TR SILICON NPN	NEC 2SD880-Y
Q1219	30-40-8802	TR SILICON NPN	NEC 2SD880-Y
R491	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R492	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R501	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R611	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R801	40-27-0562	FXD C FILM 56 OHM 5% 1/4W	
RV108	46-20-3101	VAR M GLAZE 10K OHM B	
RV208	46-20-3101	VAR M GLAZE 10K OHM B	

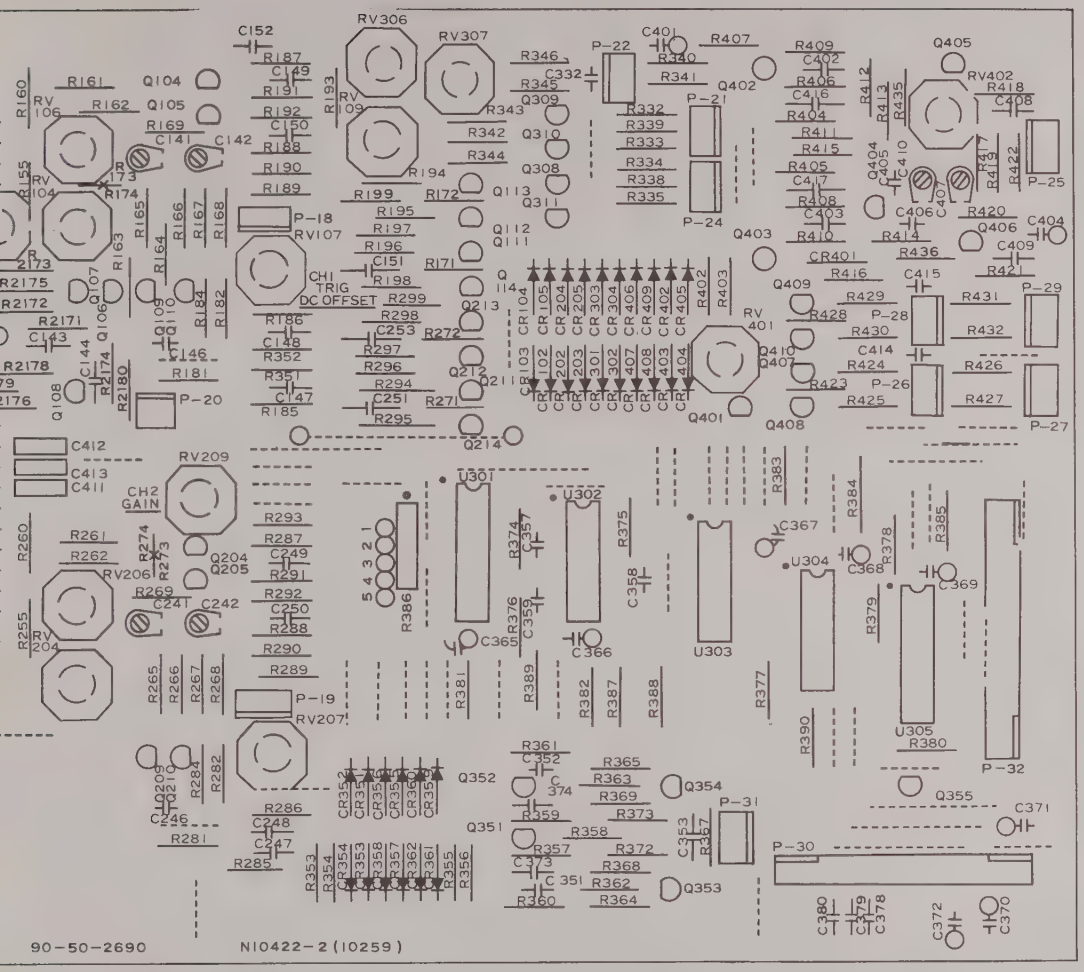
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
RV705	49-26-3100	POTENTIOMETOR 10K OHM	
RV1001	45-02-0200	VAR C COMP 10K/10K OHM B	
C1201	52-77-1000	FXD CER 1000P 250VAC	
C1202	52-77-1000	FXD CER 1000P 250VAC	
V1101	21-46-0603	CATHODE-RAY TUBE	TOSHIBA 150BEB31



A1 VERT PREAMP Pa



A2 CH3 PREAMP Pa



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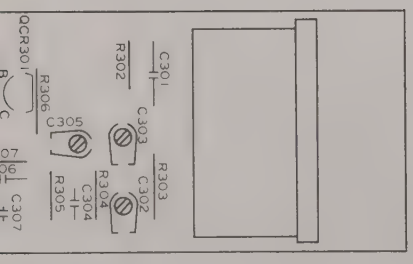
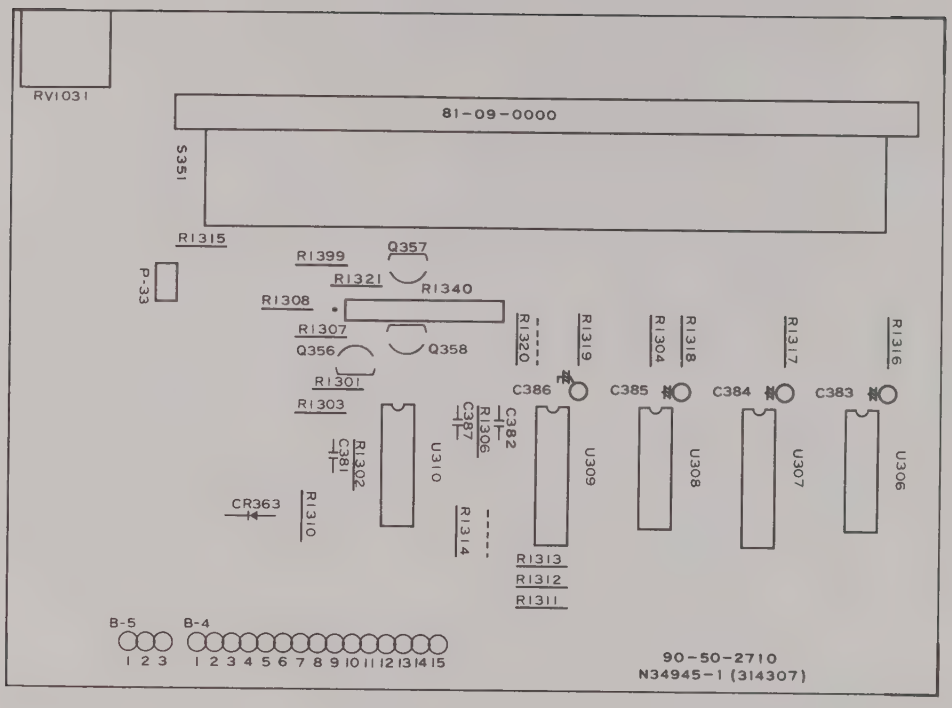
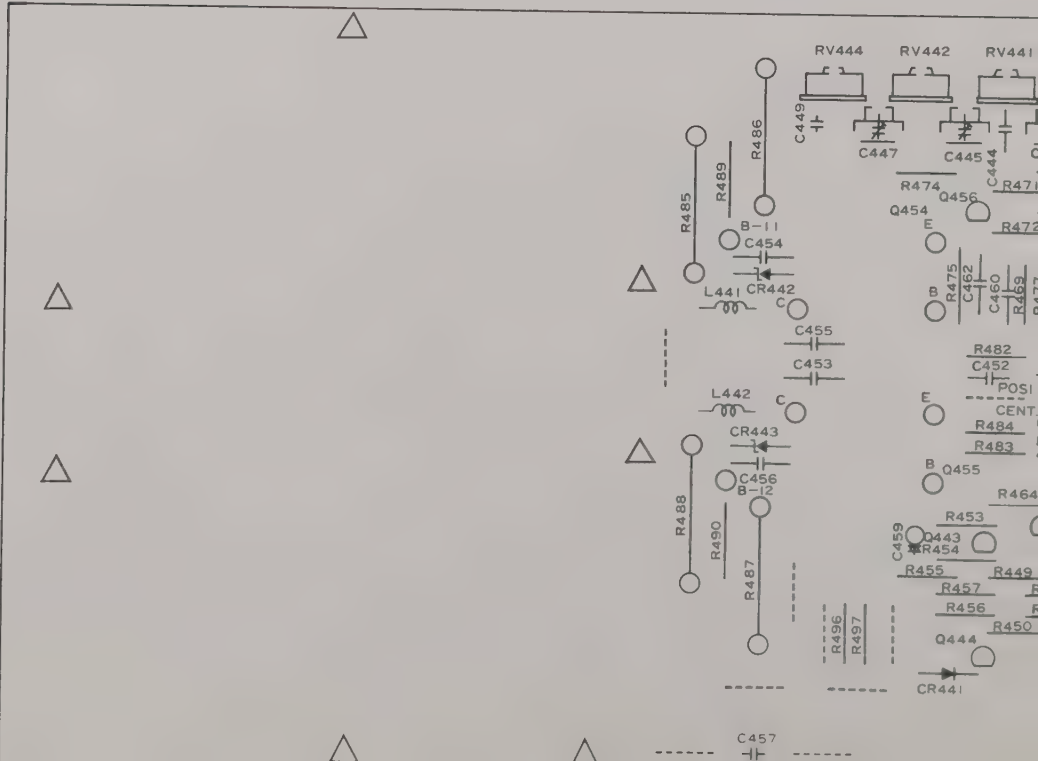
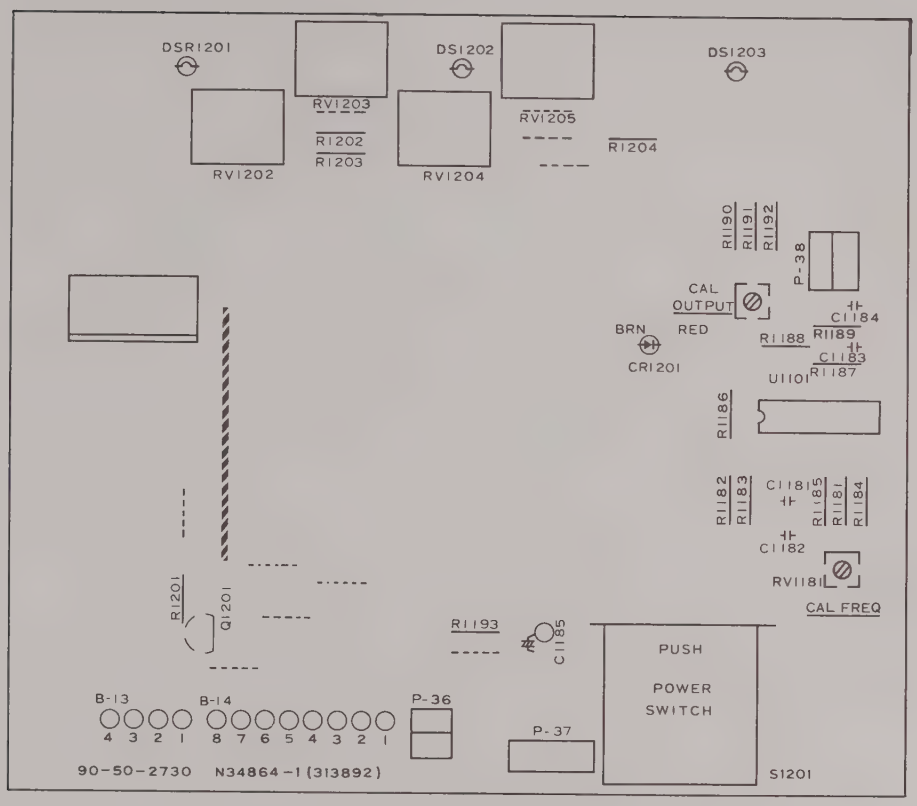


s Location

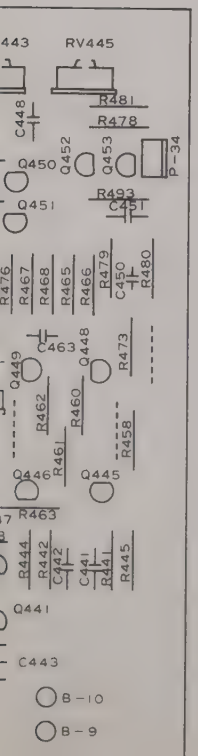


A3 VERT SWITCH CONTROL Parts Location

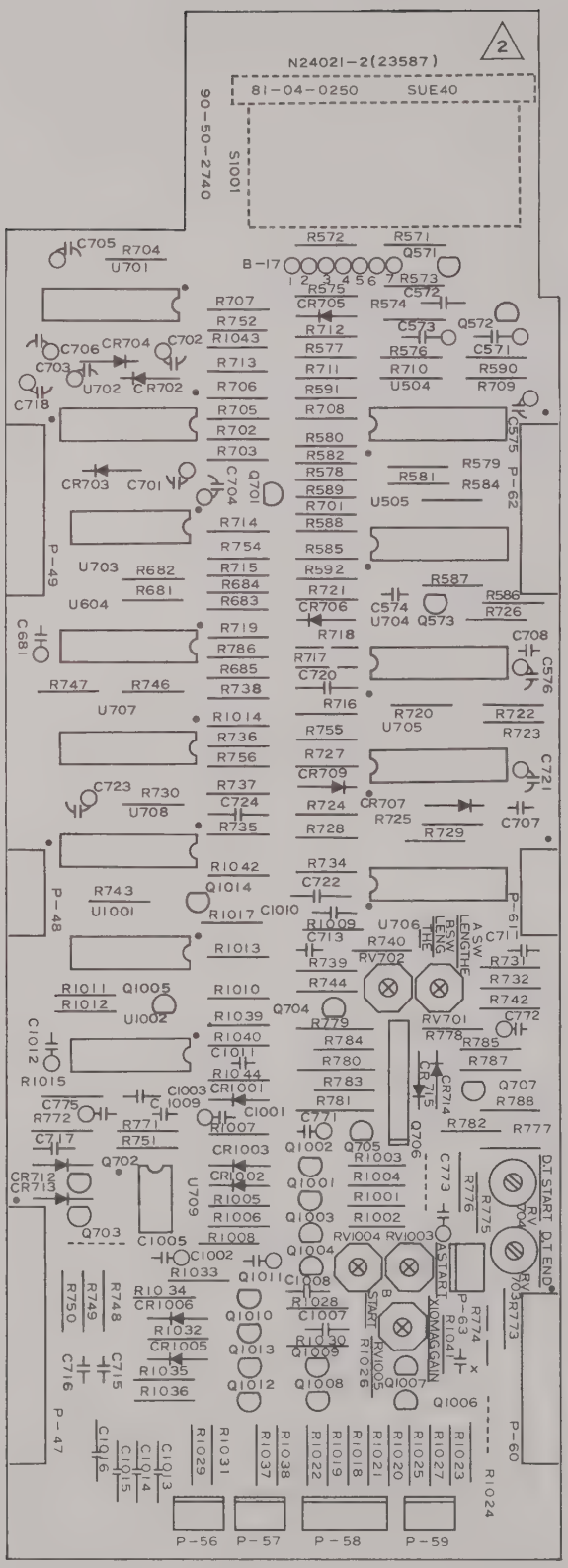




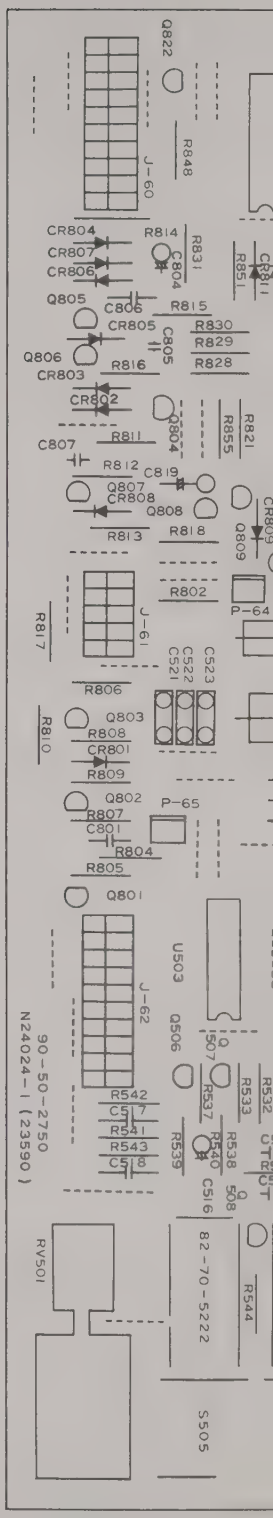
A5 CAL & CRT CONTROL Parts Location



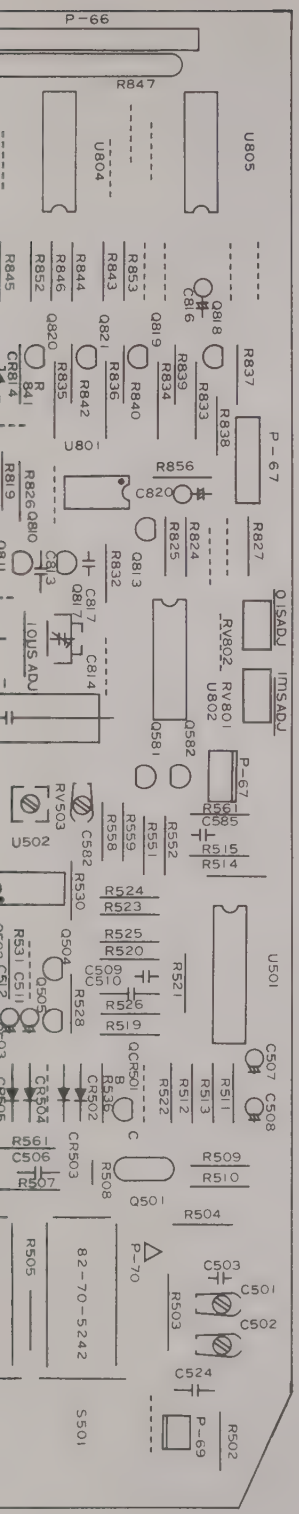
A4 VERT OUTPUT AMP Parts Location



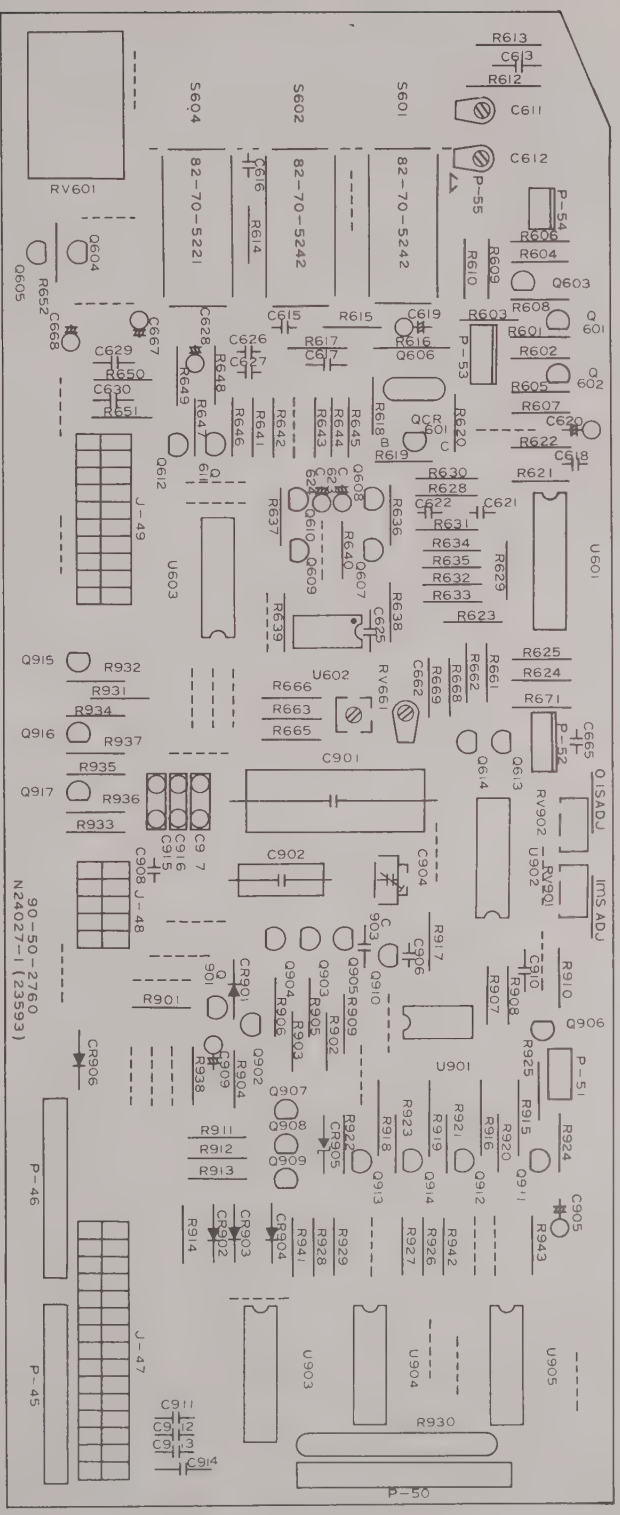
A6 TRIG & SWEEP CONTROL Parts Location



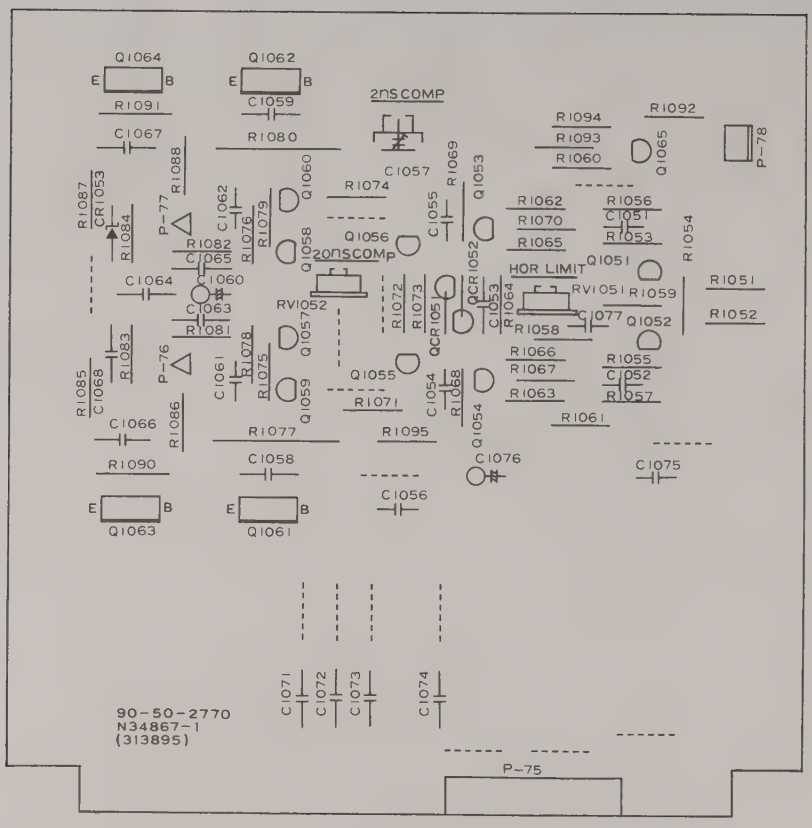
A7 A TRIG & A



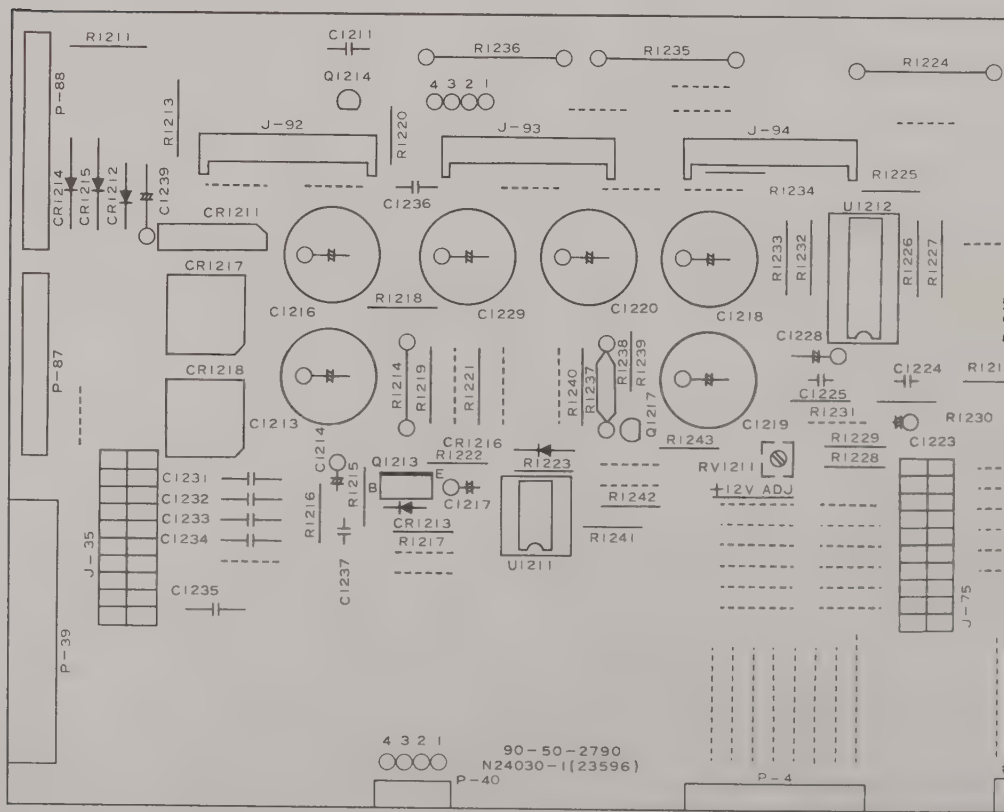
EP Parts Location

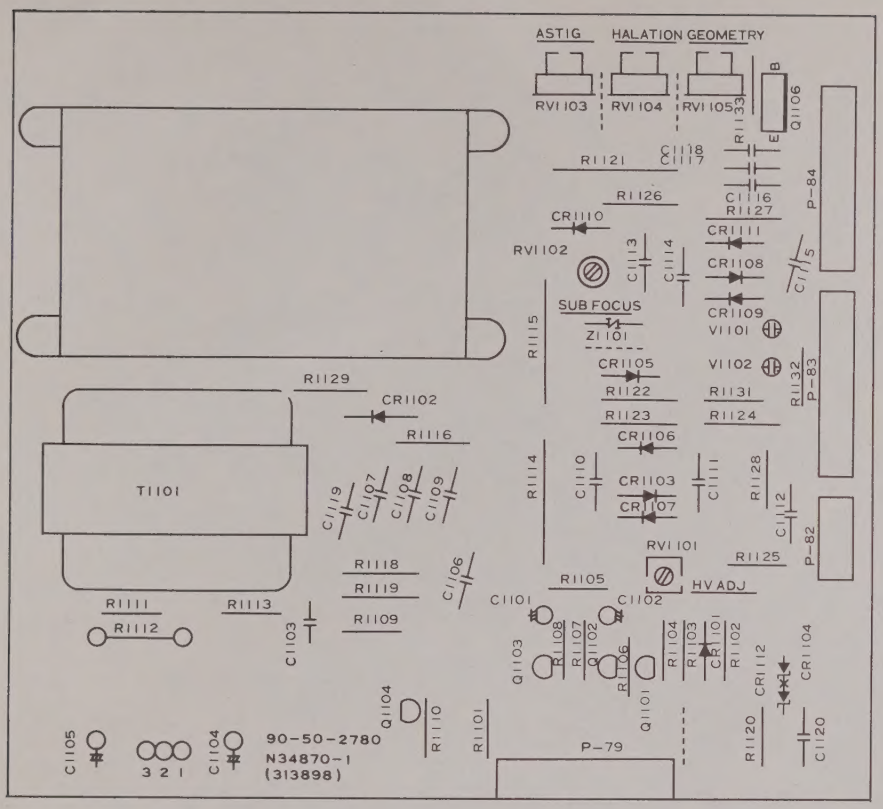


A8 B TRIG & B SWEEP Parts Location

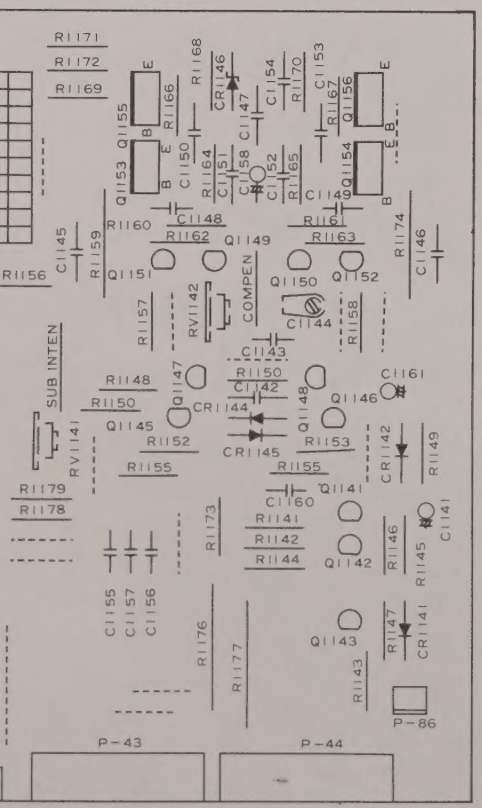


A9 HORIZ OUTPUT AMP Parts Location





A10 H.V & CRT CIRCUIT Parts Location



A11 POWER SUPPLY & Z AMP Parts Locat

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